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WATERSHED WORK PLAN
EAGLE - TUMBLEWEED DRAW WATERSHED
EDDY AND CHAVES COUNTIES,
NEW MEXICO



February 1971

Prepared under the authority of the Watershed Protection & Flood Prevention Act (Public law 566, 83rd. Congress, 68 Stat. 666) as amended.

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ADDENDUM

EAGLE-TUMBLEWEED DRAW WATERSHED

WORK PLAN

New Mexico

This addendum shows the project costs, benefits, and benefit-cost ratio based on a 6-7/8 percent interest rate, current normalized prices, and an allowance for construction costs increased from the 1970 price base to 1973:

Annual project costs, benefits, and the benefit-cost ratio are as follows:

Average annual total project benefits	\$786,920
Average annual project costs	509,580
New overall project benefit-cost ratio	1.5:1

The alternative selected for implementation, as contained in this work plan, is based on a careful and deliberate consideration of the environmental and economic impacts of the project. There are no known unresolved environmental issues. Comments on the draft environmental statement stressed the need for a more detailed description of resources and problems. The final environmental statement has been modified in response to such comments.

FEB 8 1975

December 1973

WATERSHED WORK PLAN AGREEMENT

Between the

City of Artesia

Central Valley Soil and Water Conservation District

Penasco Soil and Water Conservation District

Artesia-Eagle Draw Flood District

(hereinafter referred to as the Sponsoring Local Organization)

State of New Mexico

and the

United States Department of Agriculture

Soil Conservation Service

(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Eagle-Tumbleweed Draw Watershed, State of New Mexico, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Eagle-Tumbleweed Draw Watershed, State of New Mexico, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing consideration, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about four years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for the watershed work plan:

1. Except as hereinafter provided, the Sponsoring Local Organization will acquire without cost to the Federal Government such land rights as will be needed in connection with the works of improvement (Estimated cost \$226,200). The percentages of this cost to be borne by the Sponsoring Local Organization and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Land Rights Cost</u> (dollars)
Floodwater Retarding Structure 2B, Channel 200, Floodwater Diver- sions and Appurtenant Structures.	100	0	226,200

2. The sponsoring local organization will provide relocation advisory assistance services and make the relocation payments to displaced persons as required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. Prior to July 1, 1972, the sponsoring local organization will comply with the real property acquisition policies contained in said Act and Regulations to the extent that they are legally able to do so in accordance with their State law. After July 1, 1972, the real property acquisition policies contained in said Act shall be followed in all cases.

The Service will bear 100 percent of the first \$25,000 of relocation payment costs for any person, business, or farm operation displaced prior to July 1, 1972. Any such costs for a single dislocation in excess of \$25,000 and all costs for relocation payments for persons displaced after July 1, 1972, will be shared by the sponsoring local organization and the Service as follows:

	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Relocation Payment Costs</u> (dollars)
Relocation Payments	8.5	91.5	0

Investigation has disclosed that under present conditions the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentages shown.

3. The Sponsoring Local Organization will acquire or **provide** assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.
4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
Floodwater Retarding Structure 2B, Channel 200, Floodwater Diver- sions and Appurtenant Structures.	0	100	5,887,900

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Engineering Cost</u> (dollars)
Floodwater Retarding Structure 2B, Channel 200, Floodwater Diversions and Appurtenant Structures.	0	100	356,600

6. The Sponsoring Local Organization and the Service will each bear the costs of Project Administration which it incurs, estimated to be \$20,900 and \$621,600 respectively.
7. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.
8. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the Watershed Work Plan.
9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
10. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.
11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.
14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or natural origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.

CITY OF ARTESIA

Local Organization

By

Title

Address

Zip Code

Date

The signing of this agreement was authorized by a resolution of the governing body of the City of Artesia adopted at a meeting held on 1-12-71.
(Local Organization)

(Secretary, Local Organization)

Address

Zip Code

Date

CENTRAL VALLEY SOIL AND WATER
CONSERVATION DISTRICT

Local Organization

By R. L. Bowman

Title Chairman

Address 2110 N. Freeman Avenue 88210
Zip Code

Date 8-10-71

The signing of this agreement was authorized by a resolution of the
governing body of the Central Valley Soil and Water Conservation District
(Local Organization)

adopted at a meeting held on 1-6-1971

Charles Jenkins
(Secretary, Local Organization)

Address 1040 Osborn Avenue 77411 88210
Zip Code

Date 8-16-1971

PENASCO SOIL AND WATER
CONSERVATION DISTRICT

(Local Organization)

By Lewis Weddige

Title Chairman

Address Hope, N. M. 88250
Zip Code

Date 8-23-71

The signing of this agreement was authorized by a resolution of the
governing body of the Penasco Soil and Water Conservation District
(Local Organization)

adopted at a meeting held on 1/11/71

Ernest R. Harwell
(Secretary, Local Organization)

Address Parish, N. M. 88344
Zip Code

Date 8/23/71

ARTESIA-EAGLE DRAW FLOOD DISTRICT

(Local Organization)

By

T. E. Vandiver

Title Eddy County Flood Commissioner

Address Box 1309 Artesia NM 8

Zip Code

Date 8-16-71

Board of County Commissioners of
Eddy County, New Mexico

By

By

By

The signing of this agreement was authorized by a resolution of the governing body of the Artesia-Eagle Draw Flood District adopted at
(Local Organization)

a meeting held on 1-19-71

W. H. Taylor
(Secretary, Local Organization)

Address Box 1305 Artesia NM 8

Zip Code

Date 8/24/71

Soil Conservation Service
United States Department of Agriculture

By

Title

Date

W O R K P L A N
FOR
WATERSHED PROTECTION AND FLOOD PREVENTION
EAGLE-TUMBLEWEED DRAW WATERSHED
EDDY AND CHAVES COUNTIES, NEW MEXICO

Prepared Under the Authority of the Watershed
Protection and Flood Prevention Act (Public Law
566, 83rd Congress; 68 Stat. 666), as amended

Prepared By:

City of Artesia
(Sponsor)

Central Valley Soil and Water Conservation District
(Sponsor)

Penasco Soil and Water Conservation District
(Sponsor)

Artesia-Eagle Draw Flood District
(Sponsor)

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service

U. S. Department of Interior
Bureau of Land Management

State of New Mexico

February 1971

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WATERSHED WORK PLAN

EAGLE-TUMBLEWEED DRAW WATERSHED EDDY AND CHAVES COUNTIES, NEW MEXICO

FEBRUARY 1971

SUMMARY OF PLAN

GENERAL SUMMARY

The Eagle-Tumbleweed Draw Watershed is located in southeastern New Mexico in portions of Eddy and Chaves Counties. The watershed area includes 288.1 square miles, 184,400 acres, of which 85.5 percent is rangeland, 7.2 percent is cropland, and 7.3 percent is in miscellaneous use such as farmstead, roads, railroads, and urban developments.

This plan is sponsored by the City of Artesia, the Central Valley and Penasco Soil and Water Conservation Districts, and Artesia-Eagle Draw Flood District. Technical assistance has been provided by the Soil Conservation Service, United States Department of Agriculture, by the Bureau of Land Management, United States Department of Interior, and by the State of New Mexico.

Flooding which inundates large areas of the City of Artesia and adjacent high-value cropland and damages urban and agricultural property and crops is a major problem.

The objectives of this plan are to accelerate needed land treatment on watershed lands and to provide protection to lives and property from floods.

LAND TREATMENT MEASURES

Land treatment measures will be established and maintained by landowners and operators of watershed lands and by the Bureau of Land Management during the four-year project installation period. Proper grazing use of all rangeland will be emphasized on the upland part of the watershed which is primarily rangeland.

Land treatment measures for the irrigated cropland in the lower reaches of the watershed will consist primarily of those practices needed for conservation and efficient use of irrigation waters.

The estimated cost of land treatment measures is \$397,500. The Public Law 566 share is \$9900 and will consist entirely of accelerated technical assistance. The share borne by the other funds is \$387,600, of which

\$13,900 is from the Soil Conservation Service going program of technical assistance, \$500 is from the regular funds of the Bureau of Land Management, and \$373,200 is for application and installation of on-farm and on-ranch measures paid for by landowners or operators with assistance as available from the Agricultural Conservation Program, Great Plains Conservation Program, or other sources.

STRUCTURAL MEASURES

The structural measures included in the plan are a floodwater retarding structure, two diversions and an outlet channel. The floodwater retarding structure (Site 2B), the diversions (FD-1, FD-2) and the channel to 26th Street (Channel 200) will be constructed with PL-566 funds. The channel from 26th Street to the Pecos River will be the responsibility of the sponsoring local organizations and will be constructed prior to signing of any project agreement for the expenditure of PL-566 funds through construction contracts.

The estimated installation cost of the structural measures is \$7,113,200. PL-566 funds will bear an approximate amount of \$6,866,100 and the local sponsors will bear approximately \$247,100.

OPERATION AND MAINTENANCE

Land treatment measures will be maintained by the landowners and operators of farms and ranches on which the measures are installed under agreement with the Central Valley and Penasco Soil and Water Conservation Districts. The Bureau of Land Management will maintain the land treatment on land administered by them.

The operation and maintenance of structural measures will be the responsibility of the Artesia-Eagle Draw Flood District. Annual operation and maintenance cost of structural measures to be installed with PL-566 funds is estimated to be \$19,980.

ANNUAL BENEFITS

Average annual benefits accruing to structural measures are estimated to be \$879,800 distributed as follows:

Floodwater Damage Reduction	\$719,800
Redevelopment	95,600
Secondary	<u>64,400</u>
TOTAL	\$879,800

In addition to the above benefits, there will also be average annual flood damage reduction benefits in Damage Areas 1 and 4 on the north side of Artesia.

These benefits will accrue to measures installed in the Cottonwood-Walnut Creek Watershed and are distributed as follows:

Floodwater Damage Reduction	\$188,000
Secondary Benefits	<u>16,300</u>
TOTAL	\$204,300

In Damage Areas 1 and 4, runoff from a portion of the Cottonwood-Walnut Creek and the Eagle-Tumbleweed Draw Watershed overlap, resulting in a common damage area.

Floodwater Diversion 8 (FD-8) of the Cottonwood-Walnut Creek Watershed will collect this runoff and divert it to a floodwater retarding structure in the Cottonwood-Walnut Creek Watershed.

The ratio of average annual benefits from structural measures (\$879,800) to the average annual cost of structural measures (\$387,000) is 2.3:1 (Table 6).

DESCRIPTION OF THE WATERSHED

The Eagle-Tumbleweed Draw Watershed is located in southeastern New Mexico in parts of Eddy and Chaves Counties and is adjacent to and south of the Cottonwood-Walnut Creek Watershed. The City of Artesia, with a population of 10,000, is in the watershed. The Village of Hope, about 20 miles west of Artesia, is on the southern edge of the watershed. The watershed has an area of approximately 288.1 square miles (184,400 acres). About 52,900 acres are administered by the Bureau of Land Management and 45,400 acres by the State of New Mexico. The remaining 86,100 acres are in private ownership. Approximately 112.8 square miles of the watershed area are in Chaves County with the remaining 175.3 square miles in Eddy County.

The watershed includes Eagle and Tumbleweed Draws which are tributaries to the Pecos River. Eagle Draw heads at an elevation of about 6,400 feet above mean sea level in the foothills of the Sacramento Mountains about 50 miles west of Artesia. The watershed is approximately 55.5 miles long with an average width of five miles. The water course is fairly well-defined in the upper reaches of the watershed to the west edge of the Pecos River Valley where the topography becomes more level and gently sloping. At this point, in Sections 22 and 23, Township 17

South, Range 25 East, the channel becomes rather undefined. The flows spread and divide into the north and south branches which subsequently fan out inundating large areas of the City of Artesia and surrounding irrigated farmland. Eagle Draw has no defined course to the Pecos River. The north branch flows through the City of Artesia, and the south branch flows along the south edge of the city. The north boundary of Eagle Draw is the southern boundary of the Cottonwood-Walnut Creek Watershed.

Tumbleweed Draw heads about 17 miles west of the Pecos River. The north boundary of Tumbleweed Draw coincides with the south boundary of Eagle Draw. Tumbleweed Draw drains through a small low-lying agricultural area before draining into the Pecos River through a well-defined channel east of the agricultural area.

There are three major range sites within the watershed: bottomland - on the lower reaches of the watershed and along the drainage ways; loamy - on a large area through the center of the watershed; and shallow - in the western half of the watershed above Hope and in complex with the loamy site. The climax vegetation consists of black grama, blue grama, sideoats grama, alkali sacaton, giant sacaton and tobosa grass. Increaser plants include burro grass, cat claw, creosote bush, tar bush, mesquite and cholla cactus.

GEOLOGY AND GEOMORPHOLOGY

The watershed is located in the Pecos Valley section of the Great Plains Physiographic Province. Eagle Creek, in the upper 27-mile reach of the watershed, is underlain by the hard limestone of the San Andres Formation of Permian Age.

The drainage in the lower 27-mile reach is called Eagle Draw where it flows across a composite surface resulting from the formation and partial destruction of three terraces which generally form a series of broad steps rising from the Pecos River. The relief increases toward the west where Eagle Draw and Catclaw Draw, which are tributaries to Eagle Draw, have cut two broad U-shaped valleys 50 to 80 feet below the general surface of the oldest alluvial terrace. A large mesa capped by a conglomerate composed of limestone gravels is located on the northern edge of the watershed about five miles north of Hope. The mesa is much higher and older than any of the terraces. The terraces, in ascending order, are the Lakewood, the Orchard Park and the Blackdom Terraces.

The Lakewood Terrace is developed along a narrow strip adjoining the Pecos River and in a narrow strip up the valley where the Eagle Draw formerly flowed. The alluvium composing the Lakewood Terrace is primarily brown silt or clay with interbedded lenses of sand and gravel. Westward from the Pecos River, the proportion of fines to sand and gravel decrease so that near the western edge in the vicinity of Hope, the materials are limestone pebbles, cobbles and boulders.

The Orchard Park Terrace rises five to ten feet above the Lakewood Terrace. In many places there is a distinct topographic break between the Lakewood and the Orchard Park Terraces, but in the watershed area there is a more gradual change in slope. The Orchard Park Terrace occupies a five-mile wide belt on which the City of Artesia and the farmlands are located. The deposits of the terrace consist chiefly of silt, clay, sand and gravel derived from the Sacramento Mountains and from the Blackdom Terrace. The gravel consists of subangular to well-rounded limestone. The silt and clay in the deposits of Orchard Park Terrace are light brown to tan in color and are calcareous.

The Blackdom Terrace rises 30 to 50 feet higher than the Orchard Park Terrace. The deposits of the terrace consist of materials derived from the limestone uplands and the Sacramento Mountains. They consist largely of lenticular beds of gravel, conglomerate, clay, and silt.

Solution-faceted limestone gravels in deposits cemented by caliche or calcium carbonate are found in the terrace. The caliche is generally hard at the top and decreases in hardness downward and at times has been mistaken for massive normal marine limestone outcrops.

The conglomerate capping the mesa north of Hope is 5 to 20 feet thick and rests unconformably on red beds and limestone of Permian Age. The terrace deposits and the conglomerate cap are estimated to be of Pleistocene Age, with the exception of the Lakewood Terrace which was deposited in Recent time. The terraces appear to be constructional features resulting from the deposition of alluvial material by the Pecos River, primarily by its tributaries from the west during three distinct phases separated by stages of downcutting and trenching of streams.

SOILS

Soils in the watershed are generally shallow and rocky in the western one-half and deep and loamy in the eastern one-half.

A general soils map (Figure 1) portrays the soil patterns. The legend on the map lists the soil characteristics.

CLIMATE

Average annual precipitation is 11.75 inches as derived from precipitation records of Artesia. Most of the precipitation falls as high intensity rain during thunderstorms of comparatively short duration. Extremes in annual precipitation range from a low of 3.97 inches in 1917 to a high of 36.31 inches in 1941.

The climate is dry and moderately hot, with a mean average annual temperature of 60.8 degrees Fahrenheit. The average frost-free period is 196 days extending from April 11 to October 17.

ECONOMIC DATA

The City of Artesia, with a population of 10,000, is located within the watershed and is a primary trading center. The projected population by the year 2000 is expected to be about 34,000. Currently, there are about 2400 family home units in and around the City of Artesia. This is expected to increase to about 6800 by the year 2000.

The watershed is presently included in an area designated by the Public Works and Economic Development Act of 1965 as being an area of chronic unemployment and underemployment. In the near future, new industry in the area is expected to provide direct employment to approximately 300 people. This will be the result of an expected increase in industrial development, both agricultural and nonagricultural. Examples are a proposed methane plant and an expected increase in vegetable production. The recently established College of Artesia will also enhance the growth potential for the area. Further economic stimulus will be provided by the planned watershed project.

U. S. Highway 285 and the Santa Fe Railroad cross the lower reach of the watershed. The irrigated cropland is well served by state and county roads.

The upper reach of the watershed, of which 45,390 acres is state land, is rangeland devoted to cattle and sheep production. Present cattle feeding operations show promise and indicate an increase in similar ventures. This would require more feed grains and ensilage crops be raised.

Status of present land use is as follows:

Land Use	Private	State	Bureau of Land Management		Total	Percent
			Type I <u>1/</u>	Type IV <u>1/</u>		
-----acres-----						
Cropland	13,430	---	---	---	13,430	7.2
Rangeland	59,192	45,390	19,690	33,230	157,502	85.5
Misc. <u>2/</u>	13,468	---	---	---	13,468	7.3
TOTAL	86,090	45,390	19,690	33,230	184,400	100.0
PERCENT	46.7	24.6	10.7	18.0	100.0	

1/ Type I - Best Blocked, Type IV - Transfer

2/ Includes all other lands

The principal crops grown on irrigated land in the watershed are alfalfa (55 percent) and cotton (37 percent). Annual crop production averages about six tons of hay per acre for alfalfa and one bale per acre for cotton. Other crops grown are corn, grain sorghum, castor beans, oats, barley, and vegetables. The gross value of present agricultural production within the watershed is about \$3,400,000 annually. Irrigated cropland is divided into 139 operating units which range in size from 20 acres to 640 acres. Average size of farm operations in the irrigated portion of the watershed is 185 acres. The present market value of irrigated cropland ranges from \$800 to \$1000 per acre. There are approximately 30 ranches in, or partially within, the watershed.

All of the cropland is irrigated from wells except the cropland in the Hope area which is irrigated when water is available from flood flows in the Rio Penasco. Farming operations in the Hope area are limited to some small grains and forage crops for production of livestock.

The general pattern of farm operations in the area is approximately one-half commercial and one-half family farms. Most farms in the area use hired labor. About 50 percent of the farms utilize 18 man months of labor per year.

Cropland in the irrigated Pecos Valley is highly productive and typically characterized as highly developed agricultural units. Farm incomes are for the most part adequate but can be improved by the adaptation of new farming and management techniques and varieties of crops. Land, labor, and capital appear to be fully employed although opportunity exists for more efficient use of labor.

Possibilities exist for expansion of the agricultural industry in marketing and processing. Establishment of vegetable handling and packing facilities and establishment of a beef slaughter operation in the area when cattle numbers increase so that such an industry could be supported are two possibilities having considerable potential.

LAND TREATMENT

The Penasco and Central Valley Soil and Water Conservation Districts have provided leadership in the development of basic conservation programs on farms and ranches within the watershed for more than 20 years. These programs are based on the use of each acre within its capabilities and its treatment according to its needs, and are considered an essential part of the watershed program. The soil and water conservation districts have made an inventory of land treatment which has been applied to date. This is listed in Table 1A.

The work unit office of the Soil Conservation Service is providing technical assistance to the Central Valley and Penasco Soil and Water Conservation Districts. Farmers and ranchers in the watershed have been

assisted in the preparation of 99 basic conservation plans on 113,769 acres. Approximately 55 percent of the needed land treatment has been applied. The land treatment measures and their costs are listed in Table 1A.

Most of the watershed is covered by rangeland. The cropland is concentrated in the lower reaches along the Pecos River. Little improper land use occurs.

Cropland in the Hope area near the center of the watershed is irrigated when water is available from flood flows in the Rio Penasco. When water is not available, this cropland is dry farmed. It is susceptible to wind erosion damage unless plant residues are managed or emergency tillage measures are used when needed.

Irrigated land in the lower reaches of the watershed is irrigated from wells. By a recent District Court decision, a five-year average gross duty of water amounting to 3.5 acre-feet per acre per year measured at the well is permitted for irrigation purposes on groundwater-right land.

FISH AND WILDLIFE

Eagle and Tumbleweed Draws have intermittent flows only. They support no fishery. Wildlife species in the drainage are associated with the cultivated lands of the valleys, upstream rangelands, and tributary and main draws. Upland game include rabbit, mourning dove, scaled quail and a few ring-necked pheasant and mule deer.

W A T E R S H E D P R O B L E M S

LAND TREATMENT

Annual rates of erosion are low throughout the watershed because of gentle slopes in the lower part and good grass cover on the upper part of the watershed. Annual erosion rates on the cropland area are not significant because only level or nearly level land is used for cultivation. Sheet erosion accounts for almost all of the erosion.

Cropland is generally located on deeper soils and more level lands in order to obtain the most efficient use of irrigation water. Cropland in Hope lacks a sufficient water supply. Presently it is producing more feed for livestock than would be possible with rangeland. The erosion hazard is slight on this land if properly managed.

Some land use adjustments are expected to occur during the project period due to increased urbanization around the City of Artesia.

Landowners and operators are financially able to apply needed conservation measures and participate with the Great Plains Conservation Program and the Agricultural Conservation Program. Cropland in the lower portion of the watershed is valued at approximately \$1000 per acre with alfalfa, cotton and other high-income crops being grown. The average of 3.5 acre-feet per acre permitted to be pumped may cause some farmers to convert a part of their alfalfa acreage with its high consumptive use of water to other crops having a lower consumptive use.

FLOODWATER DAMAGE

The long, narrow shape of the watershed precludes formation of high flood peaks from storms covering the entire watershed as would normally be expected from a watershed of this size. Runoff from the lower portion of the watershed has passed before flows from the middle and upper reaches come into Artesia and the surrounding agricultural area.

Floodwater damages result from floods caused by two types of storms over the drainage area:

1. Local thunderstorms covering a few square miles with short duration and high intensities. Floods from this source characteristically have high peak flows, small volumes and are of short duration.
2. General storms over all or most of the watershed with comparatively long durations. Floods from this source characteristically have large volumes, are of long duration and may have peaks exceeding those from local thunderstorms.

Damaging floods from local thunderstorms normally occur during summer and early fall months, while damaging floods from general storms occur from spring to late fall. Floods, inundating areas of Artesia and large acreages of the surrounding cropland, occur on an average of once every three or four years. Damaging floods have occurred in 1905, 1908, 1911, 1919, 1928, 1937, 1941, 1948, 1954, 1964 and 1966.

Based on available records, the 1954 and 1964 floods would have recurrence intervals of 40 and 30 years respectively. The 1954 flood was caused by a general-type storm covering most of the watershed while the 1964 flood was caused by a high-intensity thunderstorm covering approximately 50 square miles of the Eagle Draw Watershed located just west of Artesia. The storm also covered 30 square miles of the Cottonwood-Walnut Creek Watershed just northwest of Artesia.

The 1964 flood inundated approximately 2400 acres of cropland causing direct agricultural damages estimated at \$504,000. It also caused an estimated \$1,487,000 of direct damages to the City of Artesia. Total estimated direct damages from the flood amounted to \$1,997,000.



SCS PHOTO 12-P488-9

TYPICAL FLOODWATER DAMAGE

When flooding occurs in Artesia, four separate areas within the city become inundated. In some locations, depths of flooding are in excess of three feet. It is estimated damages in the watershed begin with a storm having a 25 percent chance of occurrence.

In northern Artesia, there is an overlapping effect between the Eagle-Tumbleweed Draw and Cottonwood-Walnut Creek Watersheds when flooding occurs. Consequently, damages in these two areas are caused by flooding from both the Cottonwood-Walnut Creek and the Eagle-Tumbleweed Draw Watersheds.

The city is being forced to expand throughout the four damage areas. Consequently, if the city remains unprotected, it will face increasingly greater damages in its future growth.

Within the one damage area in the northern section of the city, an urban renewal project includes the building of an anticipated 144 homes that would be subject to damage from flooding. A projection of 486 homes is expected to be constructed in this same damage area but outside the urban renewal area which would be subject to flood damage.

In two of the other damage areas, a future projection of 972 homes is anticipated to be built. These would also be subject to flood damages.

In the fourth damage area, it is projected that approximately 175 homes having a value of \$13,000 to \$18,000 will be built. These would also be subject to flood damage.

This amount of projected home building is based on present trends of expansion and is expected to continue regardless of whether or not a project is installed.

INDIRECT DAMAGE

Indirect damage from flooding results from interrupted use of farm labor, interruption of businesses, industry and communications. Other damages include delays and detours for road and railroad traffics, increased cost of business operations, and higher transportation costs. This amounted to an estimated \$281,000 from the 1964 flood.

EROSION DAMAGE

Erosion of the watershed soils is low and is occurring primarily on range-land in the upland portion of the watershed. The average annual gross erosion rate is estimated to be 0.40 acre-foot per square miles. It is estimated sheet erosion accounts for 85 percent of the damaging sediments. Gullying and streambank erosion accounts for the remaining 15 percent. No significant erosion occurs in the damage area with the exception of some minor scouring which has been included under floodwater damage.

AVERAGE ANNUAL DAMAGES

Average annual floodwater damages in the watershed including projected future growth are as follows:

Agricultural	\$ 66,500
Nonagricultural	740,800
Indirect	<u>123,000</u>
TOTAL	\$930,300

The damage includes \$188,000 of average annual damages caused by flooding from the Cottonwood-Walnut Creek Watershed in northern Artesia.

PROBLEMS RELATING TO WATER MANAGEMENT

Surface drainage of agricultural land within the watershed is not a major problem. Adequate drainage facilities have been installed and are being maintained by the farmers.

Irrigation of cropland in the lower portion of the watershed along the Pecos River is by both artesian and shallow wells. The present supply is adequate in quantity and quality. However, water continues to be mined, and quality is likely to worsen with time. The City of Artesia has an adequate water supply and can always afford to obtain municipal water by acquiring water rights from irrigation.

Cropland within the watershed in the Hope area is irrigated by diversion of flood flows from the Rio Penasco, an adjacent watershed to the south of Eagle Draw. This cropland is devoted to the production of forage crops. The water supply is inadequate and erratic.

The surface water of the Pecos River and its tributaries and the ground-water of the declared underground water basins in which the Eagle-Tumbleweed Draw Watershed is situated are fully appropriated, and water is not available for increased beneficial consumptive use. The two declared underground basins are the Penasco and Roswell Artesian.

P R O J E C T S O F O T H E R A G E N C I E S

Currently, the Renewal Assistance Administration of the Department of Housing and Urban Development is administering the Eagle Urban Renewal Project in Artesia. Work being done includes construction of the enlargement of Eagle Draw within the city limits.

The channel enlargement will be connected to Channel 200 at 26th Street and will drain into the channel works of the Artesia-Eagle Draw Flood District at the east edge of Artesia. Approximately 8800 feet of channel has been installed within the city limits as a part of the Urban Renewal Project with the remaining 7800 feet of channelization within the city to be done as part of another urban renewal project. From the east end of the Urban Renewal Channel to the Pecos River, approximately 14,900 feet of channel has been constructed by the Artesia-Eagle Draw Flood District.

Consulting engineers have contacted the SCS and have designed these channels with sufficient capacity to convey the planned flows.

P R O J E C T F O R M U L A T I O N

The Central Valley and Penasco Soil and Water Conservation Districts have been instrumental in the installation of the conservation measures within the watershed since their organization in the 1940's. Since the approval of the watershed application of planning, the installation of land treatment measures has accelerated.

During the work plan formulation, the local sponsors met with local representatives of the Soil Conservation Service, Agricultural Stabilization and Conservation Service, Extension Service and Bureau of Land Management. From plans and agreements reached at these meetings, the local sponsors set the following goals:

1. To have in excess of 80 percent of the total land treatment needs on the land at the end of the project installation period. Estimated costs of land treatment are shown in Table 1.
2. To achieve protection in the urban area of Artesia from the 100-year flood event.
3. To achieve protection in the irrigated agricultural lands inundated from the 10-year event or greater.

Damage areas and problems within the watershed were identified with the assistance of the local people. The initial investigation revealed land treatment alone would not meet the objectives due to topography and climatic conditions, although land treatment is needed for watershed protection. Floodwater retarding structures with outlet channels to discharge into the Pecos River were needed as the solution for achieving the flood prevention objectives. Potential floodwater retarding structure sites were located to protect the damage areas. In selecting sites for the structural measures, consideration was given to those structures which could provide the maximum protection from floodwater and sediment damage.

Consideration was given to five floodwater retarding structure sites with associated outlets. A site was located on Tumbleweed Draw. It was investigated in detail to provide protection to the irrigated agricultural land below but could not be justified. Other possible sites on Tumbleweed Draw could not be located, so the sponsors eliminated protection to the agricultural lands being flooded by Tumbleweed Draw from their objectives.

The other four sites given consideration were on Eagle Draw. One of these sites was found to be located too far west of Artesia to provide the needed flood protection to the urban area. It was investigated in detail but could not be economically justified.

Another site is located immediately west of 26th Street. This is a feasible site but is not consistent with the objectives of the sponsors because it would limit expansion of the city park area located immediately west of 26th Street. An alternative site was located one and a half

miles west of 26th Street. Present and potential high oil production precludes utilizing this site.

Site 2B is located three and one-half miles west of 26th Street and is situated west of the high oil production potential. Since the site is three and one-half miles west of Artesia, the uncontrolled area below is sufficient to produce runoff to contribute to remaining damages in Flood Damage Area 3 of Artesia. Therefore, this system required two floodwater diversions in addition to the retarding structure and outlet channel to meet the sponsors' objectives of providing protection to the urban area from the 100-year flood event. Alternative outlet channel and floodwater diversion locations were investigated. This system of structural measures, in conjunction with the land treatment system, was determined to be the least costly method of meeting the sponsors' objectives.

Runoff from approximately 3.8 square miles of drainage area above and just north of Highway 83 flows through the municipal airport and then into the northwest and north portion of Artesia. The system of structural measures described above will not provide protection from this source of flooding.

During the investigation it was determined that the most feasible method of control was to divert the runoff to a floodwater structure in the Cottonwood-Walnut Creek Watershed. The necessary measures are being incorporated in the work plan for the Cottonwood-Walnut Creek Watershed.

The City of Artesia also considered an alternative which consisted of a large diversion canal and dike to direct Eagle Draw and the other smaller drainage to the south and east, around the city, and to the Pecos River via Tumbleweed Draw. This plan also included zoning the land along the north and south fork of Eagle Draw for floodways. The floodways were to be sized to contain local runoff generated by the area below the proposed diversion canal. This alternative would be very costly and would not meet the sponsors' objectives. The diversion canal collecting and diverting the runoff to Tumbleweed Draw was unsatisfactory. The consideration of zoning the land along the north and south fork of Eagle Draw for floodways and utilization of flood proofing was eliminated since positive control of the floodwater would not be realized. There would be a potential hazard to public utilities in addition to potentially creating more severe flooding in present damage areas.

WORKS OF IMPROVEMENT
TO BE INSTALLED

LAND TREATMENT

Table 1 includes cost estimates of conservation practices to be applied during the project installation period. These measures will be established by landowners and operators in cooperation with going district programs, with cost sharing assistance from the Great Plains Conservation Program, increased Agricultural Conservation Program cost sharing assistance and Public Law 566 funds for technical assistance.

Ranch operators and the Bureau of Land Management will expand their present management programs which will result in improved vegetative cover within the climatic limitations of the area.

Proper grazing use, range deferred grazing and stockwater development are the essential conservation practices to be installed on rangeland which covers 86 percent of the watershed.

On irrigated cropland, landowners and operators will install needed structural and management practices such as land leveling to properly manage the existing water supplies, to conserve the soil and to increase yields.

The total cost of land treatment measures to be installed is \$397,500. Of this amount, \$367,500 will be spent on private land and \$30,000 on federal land.

STRUCTURAL MEASURES

The structural measures to be installed include one floodwater retarding dam with an outlet channel and two floodwater diversions.

The floodwater retarding dam at Site 2B is designed for an economic life of 100 years. The principal spillway and retarding storage will provide control of 63 percent (116,000 acres) of the watershed for a storm having a one percent chance of occurrence.

The capacity of the dam below the crest of the emergency spillway crest is 14,203 acre-feet of which 1,931 acre-feet is for the anticipated 100-year sediment volume and 12,272 acre-feet is for floodwater retarding.

The dam will be built over a foundation of GP-GC and CL materials. Depth to rock is estimated to be in excess of 100 feet. Minor settlements can be expected, but large differential settlements are not anticipated.

The principal spillway will be a reinforced concrete box conduit with a riser inlet and de-energizing outlet structure. The crest of the inlet

is to be set at the sediment pool elevation from the sediment accumulation expected to exist at the end of 100 years. The sediment pool will be dry.

A concrete emergency spillway with an energy dissipating outlet is planned. The emergency spillway and principal spillway have a combined capacity to pass the routed freeboard hydrograph without overtopping the dam.

The dam will be constructed of compacted earthfill. Materials available for borrow in the reservoir area are GP-GC, GW-GC and CL (poorly-graded clayey gravels, well-graded clayey gravels and low-plasticity clay respectively).

One telephone line will be raised and three fences reconstructed at the dam site (Table 3 and Figures 4 and 4a).

Approximately 51,600 feet of channel is needed to convey the principal spillway discharge and releases from the diversions to the Pecos River. The channel east of 26th Street is being constructed and paid for by the local sponsors.

Approximately 20,100 feet of channel will be constructed from Site 2B to 26th Street with PL-566 funds. Channel 200 is planned to safely convey the principal spillway discharge and the one percent storm runoff from the uncontrolled area below Site 2B (2000 c.f.s.). Because of the natural slope and the erodibility of the material in which the channel is to be constructed, grade stabilization is needed. Concrete drop structures with the design capacity of the channel will be installed (Table 3A, Table 3C and Figures 5 and 5a).

The spoil from the channel excavation will be seeded to grass. Permanent fences on each side of the channel will be constructed to permit the establishment and management of the vegetation.

Crossings with stabilization are planned between drop structures to facilitate maintenance and provide channel inlets for a total of 0.6 square miles of local runoff. Two powerlines will be modified and seven fences reconstructed.

Two diversions will be installed. FD-1 is approximately 6500 feet long and will control 2.4 square miles. FD-2 is approximately 1600 feet long and will cut off 2.6 square miles of drainage. Each has capacity to convey the peak from a one percent chance storm event (915 c.f.s. for FD-1 and 1,112 c.f.s. for FD-2). Drop structures with the capacity of the diversions are provided where the flows enter Channel 200 (Table 3B, Table 3C and Figures 5 and 5a).

A low water crossing will be installed on FD-1. Other work will consist of relocating one water pipeline and reconstructing four fences. One fence will be reconstructed on FD-2.

EXPLANATION OF
INSTALLATION COSTS

The total estimated project installation cost is \$7,510,700, including \$397,500 for land treatment measures and \$7,113,200 for structural measures. The Public Law 566 share is estimated to be \$6,876,000 and funds from other sources are estimated to be \$634,700 (Table 1).

The local share of project installation costs for landowners and operators expenses in applying land treatment measures (includes anticipated cost sharing from Agricultural Conservation Program funds) is \$367,900.

The Bureau of Land Management will provide \$500 for technical assistance on Type I federal land. The Bureau of Land Management will request supplemental funds through normal budgetary procedures to accelerate the installation of land treatment practices. The cost of technical assistance in applying land treatment is estimated to be \$23,800, of which \$13,900 will be from Public Law 46 funds and \$9,900 from Public Law 566 funds for accelerated technical assistance.

Public Law 566 funds will bear an estimated \$6,866,100 for the installation of the structural measures. This includes the construction costs of Site 2B, Channel 200 to 26th Street, FD-1, FD-2, all engineering costs associated with these structures and all Public Law 566 administrative costs.

The local share of the structural measures' installation cost is an estimated \$247,100. This includes all costs for acquiring land rights for Site 2B, Channel 200 to 26th Street, FD-1, FD-2 and all costs of administering contracts and other local administrative costs.

Construction costs are the engineering estimates for construction which includes a contingency allowance of 20 percent to provide for unforeseen costs on the structural measures described.

Construction costs include:

1. The contract costs for the construction of structural measures.
2. Construction of necessary structures to provide controlled inlets for drainage from adjacent lands.
3. Providing needed travelways for maintenance along improved project channels.
4. The disposal of waste spoil and seeding in accordance with sound engineering design and construction principles.
5. Construction of fences needed for the proper functioning of a structural measure.

6. Payment for water as a construction material.

Included under engineering costs are the direct costs of engineers and other technicians for surveys, investigations, design, and preparation of plans and specifications for structural measures.

The land rights cost includes all costs for the following items:

1. All expenditures made in acquiring land, easements, leases and rights-of-way.
2. Raising the telephone line at Site 2B.
3. Modifying the two power lines at Channel 200.
4. Relocating the pipeline at FD-1.
5. Reconstructing three fences at Site 2B, seven fences at Channel 200, four fences at FD-1 and one fence at FD-2.
6. Modifying the road at FD-1.

Project administration costs are the Public Law 566 and other administrative costs related to the installation of structural measures, including the cost of contract administration, review of engineering plans prepared by others, government representatives and the necessary inspection service during construction to insure structural measures are installed in accordance with the plans and specifications.

The estimated schedule of obligation for the installation period covering installation of both land treatment and structural measures is shown in the following table:

Year	Measures	PL-566 Funds	Other Funds		Total
			BLM	All Other	
First <u>1/</u>	Land Treatment	2,475	125	96,775	99,375
	Structural Measures	300,000		200,000	500,000
Second	Land Treatment	2,475	125	96,775	99,375
	Structural Measures	4,000,000		30,000	4,030,000
Third	Land Treatment	2,475	125	96,775	99,375
	Structural Measures	2,566,100		17,100	2,583,200
Fourth	Land Treatment	2,475	125	96,775	99,375
TOTAL		6,876,000	500	634,200	7,510,700

1/ Project approved for operations

THE EFFECTS OF WORKS

OF IMPROVEMENT

The principal effect of the installation of project measures will be to reduce floodwater and sediment damage to the City of Artesia and cropland in the floodplain.

The installation of the project measures will not significantly affect the total basin water supply. The net difference in yield by qualitative analysis is considered to be the change in evaporation from present conditions to future conditions, which is an average annual gain of about 260 acre-feet. Benefits were not claimed for this gain.

LAND TREATMENT

Conservation treatment of cropland will result in more efficient use of irrigation water, reduce erosion and slow runoff water for better use of rainfall. Most of the crops grown within the valley are sold off the farm to provide cash income for the farmers.

Increased efficiency in irrigation water use will reduce expenses and increase yields of crops grown thereby increasing net income from these crops.

The increased farm production will provide an outlet for labor and sale of products used in farm production. It will provide added income to farm families to improve their standard of living.

Installation of land treatment practices on the upland portion of the watershed will produce on-site conservation benefits and will enhance the overall watershed project by improving forage production. These land treatment practices which will consist mostly of improved range management will not have a measurable effect on reducing runoff and sediment yields due to climatic conditions in the area.

All cover improvements which will result from this management during periods of favorable climatic conditions will serve to lengthen the useful life of the structures. These practices will result in increased production and increased income.

STRUCTURAL MEASURES

The structural measures included in this plan will reduce average annual floodwater and sediment damages to agricultural land by 69 percent with practically all flood damages to the City of Artesia being eliminated. The overall damage reduction accruing to the project will be 98 percent. The local runoff within the city is adequately drained by storm sewers.

The system of structural measures will provide protection to the urban area of Artesia from the 100-year flood event. The portion of agricultural

land east of Artesia will also be protected from the 100-year flood event due to the high level of control to the urban area above. The remainder of the agricultural land will have residual damages from runoff over the uncontrolled drainage area below Site 2B. The runoff will flow south of Artesia inundating agricultural lands as it flows east to the Pecos River. This portion of the agricultural land will be protected from the 10-year event. The structural measures will control 187 square miles of the Eagle Draw drainage area.

The value of labor for this project is considered to be thirty percent of construction costs and fifty percent of annual operation and maintenance costs. This will mean employment for many local wage earners that would otherwise be unemployed or underemployed. The benefits of this employment are known as redevelopment benefits. For this project, they are based on \$5,888,000 of construction costs and \$19,980 of annual operation and maintenance costs and would average \$95,600 per year.

The project would also produce benefits of a secondary nature. This would include increased business for local merchants and the expansion of business and industry which would provide additional local employment and increased economic activity in general. These secondary benefits are estimated to be approximately \$64,400 annually.



1966 Flood

SCS PHOTO 12-P474-3

A storm having a one percent chance of occurrence would produce a peak discharge of approximately 20,000 c.f.s. under present conditions at the point where north Eagle Draw crosses 26th Street. The flow from the June 13, 1964 flood (30-year return period) at the north Eagle Draw crossing on 26th Street was estimated to be 10,000 c.f.s. With the project in operation, the flow would have been 2000 cubic feet per second and contained within the improved channel for both the 100-year and June, 1964 flood events.

During the 1964 flood, approximately 1200 homes and 21 businesses were damaged. Six thousand three hundred acres of farmland were inundated. With the project measures installed, no homes or businesses would be damaged from a similar flood. Damage to cropland will be limited to that which would be inundated by runoff from below the structural measures and from the cropland itself.

Indirect damages, such as interruption of travel and services and the general inconvenience and nuisance of a flood, will be practically eliminated.

No loss of life has been attributed to Eagle Draw flooding although the potential for this exists. With the project installed, the hazard to health and life are greatly reduced.

No adverse effects on fish and wildlife habitat are anticipated from the planned project measures.

The entire population of the City of Artesia and 55 landowners and operators in the watershed will be beneficiaries. Approximately 13,000 acres of irrigated cropland will receive some protection from the project.

P R O J E C T B E N E F I T S

Benefits from land treatment measures will be primarily on-site conservation benefits which accrue from more efficient management of land and water. These measures will not have a measurable reduction in flooding and were therefore not evaluated.

Average annual damages under present conditions with the urban renewal channel installed are estimated to be \$742,300. The structural measures included in this plan will reduce these average annual damages to \$22,500 providing flood damage reduction benefits of \$719,800.

These benefits consist of \$624,000 of average annual direct flood damage reduction benefits and \$95,800 of average annual indirect damage reduction benefits.

-Project Benefits-

Additional average annual flood damage reduction benefits of \$188,000 would also accrue from measures installed in the Cottonwood-Walnut Creek Watershed.

Total average annual redevelopment benefits from this project would amount to an estimated \$95,600.

Annual secondary benefits are estimated to be \$64,400. These include benefits induced by and stemming from the installation of project measures. From a national viewpoint, they were not considered pertinent to the economic evaluation. At the local level, they are significant but were not used for project justification.

COMPARISON OF BENEFITS AND COSTS

The average annual costs of the structural measures is \$387,000. This includes the amortized installation cost of \$333,870, the amortized cost of project administration of \$33,150 and annual O&M costs of \$19,980.

Total average annual benefits including redevelopment and secondary benefits are estimated to be \$879,800. This results in an overall benefit cost ratio of 2.3:1 (Table 6).

The installation of structural measures included in the plan will produce estimated average annual total benefits exclusive of secondary benefits of \$815,400. The ratio of these benefits to the cost of structural measures is 2.1:1.

PROJECT INSTALLATION

Land treatment measures will be established by district cooperators over a four-year period from time of work plan development to the end of the project installation period. Approximately 15 percent of the conservation measures to be applied will be applied each year until the start of project installation period. The remaining will be applied during the project installation period.

The Soil Conservation Service will help in the planning and application of these conservation measures by providing technical assistance through the Soil Conservation Districts under going programs and through Public Law 566 funds for technical assistance.

The Bureau of Land Management will provide technical assistance on the Type I land during the project installation period. Proper grazing use

of the federally-owned range portion of the watershed will be continued by the Bureau of Land Management and the landowners. The Bureau of Land Management concurs in the provisions of this plan.

The Extension Service will assist the sponsoring organizations with the educational phase of the program by conducting general informational and farm meetings, preparing radio and press releases and using other methods of getting information to landowners and operators in the watershed. This activity will promote understanding of the plan and help to carry out the project.

The Agricultural Stabilization and Conservation Service will assist farmers and ranchers in the watershed in the application of conservation measures by providing Agricultural Conservation Program cost-sharing. Similar assistance is available through the Great Plains Conservation Program as administered by the Soil Conservation Service.

Structural measures will be installed in a three-year period. Construction of these measures will start as soon as the project is approved, all necessary land easements and rights-of-way have been obtained, operation and maintenance agreements signed and federal funds are available.

A construction schedule will be agreed upon by cooperating parties. It will be adjusted on the basis of any significant changes in the plan found necessary in the light of appropriations and progress actually made. The various features of cooperation between the sponsors and the Service will be covered in appropriate memoranda of understanding and working agreements.

The Artesia-Eagle Draw Flood District has the powers of eminent domain and is willing to exercise these powers. They will also be responsible for land rights acquisition. The city, through urban renewal, will finance and construct the channel from 26th Street to the east city limits prior to the construction of structural measures cost-shared with Public Law 566 funds.

The sponsors will submit all plans and specifications for the structural measures to the New Mexico State Engineer for filing and approval and otherwise comply with applicable state laws before issuing invitations to bid. The Artesia-Eagle Draw Flood District will also let and service the construction contracts for the structural measures but at a later date may request the Soil Conservation Service to administer the contracts.

The Soil Conservation Service will provide technical assistance in preparation of the plans and specifications, supervision of construction, preparation of contract payment estimates, final inspection, certification of completion and other related work cost-shared with Public Law 566 funds.

The Soil Conservation Service will provide construction funds for the flood-water retarding structure, the channel to 26th Street and the diversions.

FINANCING PROJECT INSTALLATION

Costs of applying necessary land treatment measures on private, state and federal land will be borne by cooperators of the Central Valley and Penasco Soil and Water Conservation Districts. These cooperators will receive cost sharing assistance, as applicable, through the Agricultural Conservation Program and the Great Plains Conservation Program and technical assistance from the Soil Conservation Service. Additional technical assistance will be made available through Public Law 566 funds to accelerate installation of land treatment measures.

The Bureau of Land Management will request funds for the cost of technical assistance for land treatment and structural treatment on public domain lands through usual budgeting and appropriation procedures.

The Artesia-Eagle Draw Flood District has been created by the Eddy County Commissioners to provide for financing local land rights costs within the project and for channel work beginning at the east city limits of Artesia and extending to the Pecos River. Construction easements will be acquired for the dam and sediment pool area, the channel and diversions, and flow-age and subordinating easements will be acquired on the remainder of the land needed. The dam site has been appraised to determine land rights costs and condemnation will be used, as necessary, to obtain the necessary land. All property owners in the flood district are being taxed one and one-half mills per thousand dollars of evaluation.

Federal assistance in carrying out the works of improvement described in this work plan will be provided under authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666) as amended.

Federal assistance in carrying out the program will be made available when local interests have obtained the necessary land, easements and rights-of-way. Financial and other assistance to be furnished by the Service in carrying out the project is contingent on the appropriation of funds for this purpose.

PROVISIONS FOR OPERATION

AND MAINTENANCE

LAND TREATMENT

Land treatment measures applied on private, state-owned and Bureau of Land Management Type IV land will be maintained by the landowner or operator. The landowners and operators have cooperative conservation agreements with the Central Valley and the Penasco Soil and Water Conservation Districts. The Bureau of Land Management and permittees will maintain land treatment measures installed on Type I land.

STRUCTURAL MEASURES

Representatives of the sponsoring local organizations and the Soil Conservation Service will make a joint inspection of the structural measures annually and after each major flood for three years following installation of the structure. The inspection(s) will be made to determine the need for maintenance and repair and, if required, when it will be accomplished. Inspections after the third year following installation will be made annually by sponsors and a report prepared by them. A copy of the report will be furnished to the Soil Conservation Service.

The operation and maintenance of the structural measures will be the responsibility of Artesia-Eagle Draw Flood District. The estimated average annual operation and maintenance cost for floodwater retarding structure Site 2B is \$6,760, and the cost for Channel 200 from Site 2B to 26th Street and the diversions is \$13,220.

Some damage to structural measures can be expected from the runoff of major storms. Items to be considered in maintaining the structural measures include, but are not limited to, the condition of the principal and emergency spillways and earthfill of the floodwater retarding structure. The outlet channel will require removal of sediment deposits, weeds and debris. The growth of grass in the channel should be promoted where possible; however, it should be mowed periodically. The outlet channel shall be maintained in such a condition that the designated flow can be conveyed safely.

The sponsoring local organization will effectively and in a timely manner effectuate all necessary maintenance and will operate the entire project in accordance with the legal permits granted for construction. The project operations will be in accordance with the state and local laws and in accordance with the limitations specified in granting such things as construction permits, etc.

The Urban Renewal Channel through Artesia and Artesia-Eagle Draw Flood District channel east of Artesia will be maintained in such a manner that the project works will operate as planned.

The Artesia-Eagle Draw Flood District and the Soil Conservation Service will enter into a specific operation and maintenance agreement prior to signing a land rights or project agreement.



TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Eagle-Tumbleweed Draw Watershed, New Mexico

Installation Cost Item	Unit	Estimated Cost (Dollars) 1/						
		P.L.566 Funds			Other			
		Federal Land	Non-Fed. Land	Total	Federal Land	Non-Fed. Land	Total	Total
LAND TREATMENT								
Soil Conservation Service Cropland Rangeland Technical Assistance	Acres To Be Treated	1,318	11,897 53,334	11,897 54,652		224,600 119,200 13,800	224,600 143,300 13,900	224,600 143,300 23,800
SCS Subtotal		1,318	65,231	66,549		357,600	381,800	391,700
Bureau of Land Management Rangeland Technical Assistance		5,300		5,300			5,300 500	5,300 500
BLM Subtotal		5,300		5,300			5,800	5,800
TOTAL LAND TREATMENT		6,618	65,231	71,849		357,600	387,600	397,500
STRUCTURAL MEASURES								
Construction								
Soil Conservation Service Floodwater Retarding Structure Channels Diversions	ea. ft. ft.		1 20,100 8,100	1 20,100 8,100		4,275,000 1,532,000 80,900		4,275,000 1,532,000 80,900
Construction Subtotal						5,887,900		5,887,900
Engineering Services								
Soil Conservation Service						356,600		356,600
Engineering Subtotal						356,600		356,600
Project Administration								
Soil Conservation Service Construction Inspection Other						356,600 265,000	20,900	356,600 285,900
Administration Subtotal						621,600	20,900	642,500
Other Costs								
Land Rights							226,200	226,200
Subtotal Other							226,200	226,200
TOTAL STRUCTURAL MEASURES						6,866,100	247,100	7,113,200
TOTAL PROJECT						6,876,000	634,700	7,510,700
SUMMARY								
Subtotal SCS						6,876,000	604,700	7,504,900
Subtotal BLM						24,200 5,800	628,900 5,800	5,800
TOTAL PROJECT						6,876,000	634,700	7,510,700

1/ Price Base 1970
2/ Estimated amount to be spent by permittees

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(At Time of Work Plan Preparation)

Eagle-Tumbleweed Draw Watershed, New Mexico

Installation Measures	Unit	Federal Land	Non-Federal Land	Total	Total Cost (Dollars) 1/
<u>LAND TREATMENT</u>					
<u>SOIL CONSERVATION SERVICE</u>					
Conservation Cropping System	Acres		10,754	10,754	21,508
Crop Residue Use	Acres		3,464	3,464	6,928
Irrigation Water Management	Acres		3,195	3,195	6,390
Grasses & Legumes in Rotation	Acres		1,415	1,415	63,675
Land Leveling	Acres		3,517	3,517	298,945
Irrigation Ditch Lining	Lin. Ft.		209,800	209,800	356,660
Irrigation Pipeline	Lin. Ft.		79,715	79,715	199,288
Irrigation Reservoir	No.		43	43	25,800
Proper Grazing Use	Acres	19,989 2/	62,951	82,940	82,940
Range Deferred Grazing	Acres		5,566	5,566	8,349
Range Pipeline	Lin. Ft.		70,400	70,400	10,560
Trough or Tank	No.		44	44	35,200
SCS Subtotal					1,116,243
<u>BUREAU OF LAND MANAGEMENT</u>					
Proper Grazing Use	Acres	10,420 3/		10,420	10,420
BLM Subtotal					10,420
TOTAL LAND TREATMENT					1,126,663

1/ Price Base 1967

2/ Type IV (Transfer) Federal Land Serviced by SCS Through Agreement with BLM

3/ Type I (Best Blocked) Federal Land

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Eagle-Tumbleweed Draw Watershed, New Mexico

(Dollars) 1/

Item	Installation Cost - PL-566 Funds			Installation Cost - Other		Total Installation Cost
	Construction	Engineering	Total PL-566	Land Rights	Total Other	
Floodwater Retarding Structure - Site 2B	4,275,000	256,500	4,531,500	142,200 ^{2/}	142,200	4,673,700
Channel 200	1,532,000	92,000	1,624,000	65,000 ^{3/}	65,000	1,689,000
FD-1	55,900	5,600	61,500	11,700 ^{4/}	11,700	73,200
FD-2	25,000	2,500	27,500	7,300 ^{5/}	7,300	34,800
Subtotal	5,887,900	356,600	6,244,500	226,200	226,200	6,470,700
Project Administration			621,600		20,900	642,500
GRAND TOTAL			6,866,100		247,100	7,113,200

1/ Price Base 19702/ Includes \$200 for raising telephone line and \$1000 for reconstructing 3 fences3/ Includes \$1000 for modifying 2 powerlines and \$2000 for reconstructing 7 fences4/ Includes \$1000 for relocating pipeline and \$500 for reconstructing 4 fences5/ Includes \$100 for reconstructing 1 fence

TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY

Eagle-Tumbleweed Draw Watershed, New Mexico

ITEM	UNIT	SITE 2B
Class of Structure		"c"
Drainage Area	Sq. Mi.	181.3
Curve No. (1 day AMC II)		81
Tc	Hrs.	22.25
Elevation Top of Dam	Ft.	3607.4
Elevation Crest Emergency Spillway	Ft.	3598.8
Elevation Crest Principal Spillway	Ft.	3580.5
Maximum Height of Dam	Ft.	56
Volume of Fill	Cu. Yds.	2,400,000
Total Capacity		
Sediment Pool	Ac. Ft.	1,931
Retarding Pool	Ac. Ft.	12,272
Surface Area		
Sediment Pool	Acres	320
Retarding Pool	Acres	1,007
Principal Spillway		
Rainfall Volume (areal) (1 day)	In.	4.60
Rainfall Volume (areal) (10 days)	In.	7.67
Capacity @ Crest Emergency Spillway	c.f.s.	2,000
Frequency Operation-Emergency Spillway	% chance	1
Size of Conduit	Dim.	2-(5' x 5.75)
Emergency Spillway		
Rainfall Volume (ESH) (areal)	In.	6.89
Runoff Volume (ESH)	In.	4.70
Tyne		R/C Chute
Bottom Width	Ft.	800
Discharge Rate (ESH)	c.f.s.	15,500
Maximum Water Surface Elevation	Ft.	3602.2
Freeboard		
Rainfall Volume (FH) (areal)	In.	15.0
Runoff Volume (FH)	In.	12.51
Discharge Rate (FH)	c.f.s.	62,000
Maximum Water Surface Elevation	Ft.	3607.4
Capacity Equivalents		
Sediment Volume	In.	0.20
Retarding Volume	In.	1.27

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TABLE 3A - STRUCTURE DATA

CHANNELS

Eagle-Tumbleweed Draw Watershed, New Mexico

Channel (No. or Name)	Station or Reach	Capacity c.f.s.		Hydraulic Gradient (Ft./Ft.)	Channel Dimensions			"n" Value		Velocity (Ft./Sec)	Excavation (Cu. Yds.)
		Req'd	Design		Bottom (Ft.)	Depth (Ft.)	Sides	Aged	As Built		
200	Site 2B to 26th Street	2,000	2,000	.0001	94	10.0	2:1	0.030	0.020	2.3	992,000

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TABLE 3B - STRUCTURE DATA

DIVERSIONS

Eagle-Tumbleweed Draw Watershed, New Mexico

Diversion	Drainage Area Sq. Mi.	Length Ft.	Capacity c.f.s.	Hydraulic Dimensions				Volume of Excavation Cu. Yds.
				Bottom Ft.	Depth Ft.	Gradient Ft./Ft.	Velocity Ft./Sec.	
FD-1	2.4	6,500	915	30	6.5	.00030	2.0	27,200
FD-2	2.6	1,600	1,112	--	4.0	.0000	5.0 1/	500

1/ At drop structure

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TABLE 3C - STRUCTURAL DATA

GRADE STABILIZATION STRUCTURES

Eagle-Tumbleweed Draw Watershed, New Mexico

Site No.	Drop Ft.	Concrete Cu. Yds.	Type of Structure
Channel 200 11 each	10	231	Drop Spillway
FD-1 1	8	90	Drop Spillway
FD-2 1	8	104	Drop Spillway

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TABLE 4 - ANNUAL COST

Eagle-Tumbleweed Draw Watershed, New Mexico

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost ^{2/}	Operation and Maintenance Cost	Total
Floodwater Retarding Structure			
Site 2B	241,150	6,760	247,910
Channel 200	87,140	12,640	99,780
FD-1	3,780	500	4,280
FD-2	1,800	80	1,880
Project Administration	33,150		33,150
GRAND TOTAL	367,020	19,980	387,000

1/ Price Base: Installation 1970, O&M ANP

2/ 100 years @ 5 1/8 percent interest

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Eagle-Tumbleweed Draw Watershed, New Mexico

(Dollars) ^{1/}

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Agricultural			
Crop and Pasture	60,300	18,400	41,900
Other Agriculture	6,200	2,100	4,100
Subtotal	66,500	20,500	46,000
Nonagricultural			
Residential	634,700	- 0 -	634,700
Commercial	105,600	- 0 -	105,600
Road and Bridge	500	- 0 -	500
Subtotal	740,800	- 0 -	740,800
Indirect	123,000	2,000	121,000
Total in this Watershed	930,300	22,500	907,800
Benefit Accruing to Measures in Cottonwood-Walnut Creek Watershed	xxx	xxx	188,000 ^{3/}
Damage Reduction Benefits From Measures in this Watershed	xxx	xxx	719,800

^{1/} Price Base ANP^{2/} Damages will occur from floods of greater magnitude than the 100-year flood, but were not evaluated.^{3/} Benefits from damage reduction in this watershed but accruing to measures in the Cottonwood-Walnut Creek Watershed.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Eagle-Tumbleweed Draw Watershed, New Mexico

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/				Average Annual Cost 4/	Benefit Cost Ratio
	Damage Reduction 2/	Redevelopment	Secondary	Total 3/		
Site 2B, Channel 200, FD-1 and FD-2	719,800	95,600	64,400	879,800	353,850	2.5:1
Project Administration					33,150	
GRAND TOTAL	719,800	95,600	64,400	879,800	387,000	2.3:1

1/ Price Base - ANP

2/ It is estimated flood damage reduction benefits from land treatment will be insignificant.

3/ In addition, there will be in this watershed \$188,000 of damage reduction benefits and \$16,300 of secondary benefits accruing to measures in the Cottonwood-Walnut Creek project.

4/ From Table 4.

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I N V E S T I G A T I O N S A N D A N A L Y S E S

E N G I N E E R I N G

Aerial photographs and United States Geological Survey topographic quadrangles were studied for possible approaches that would solve the flood problems in the watershed. After identifying the flood source areas, floodwater retarding structure and channel sites were located to control floods from these areas. The structural measures were located by considering topography at the sites and the degree of control afforded by each individual structure.

Four floodwater retarding structure sites with associated outlets were tentatively located. Three of these were surveyed. Two alternative floodwater retarding structure sites were located and surveyed.

The following surveys were made to develop data for the detailed planning of the structural measures in this plan:

1. Differential level surveys to establish mean sea level elevations at each proposed structure site.
2. Plane table alidade topographic surveys with four-foot contour intervals of the reservoir sites.
3. Differential level surveys to establish the profile and prepare cross-sections of the channels and their flood-plains.

Elevation storage curves were made from the topographic maps of the reservoir sites for proportioning and flood routing.

The floodwater retarding structures were planned using the limiting criteria for proportioning earth dams and associated spillways as set forth in Engineering Memorandum SCS-27 (rev.), Earth Dams, March 19, 1965, as supplemented. The open channels were planned using SCS Technical Release 25 criteria.

Cost estimates were based on the quantity estimates from preliminary designs and the current unit prices for similar work in this locality. Where local cost information was not available, costs for similar construction in other areas were used after being adjusted to the local conditions.

Contingencies were added to the engineer's cost estimates for the possibility of unforeseen costs.

Structure Site 2B was determined to be hazard classification "c" due to the potential loss of life and damage to valuable property in case of structural failure. Several alternative structure layouts with combinations of reinforced concrete emergency spillways were evaluated.

HYDROLOGY

GENERAL

Hydrology studies were primarily concerned with: (1) estimating historical flood frequencies for evaluation of proposed works of improvement, (2) determination of floodwater storage requirements and (3) computation and routing of design hydrographs to determine structural dimensions.

CLIMATOLOGICAL

Eight recording and non-recording precipitation stations are located in the vicinity of the watershed. Four recording precipitation stations, which are Artesia, Maljamar, Roswell and Carlsbad, have relatively long records of approximately 30 years. Duration frequency rainfall data were worked up in detail for these stations and compared to rainfall values from Weather Bureau Technical Papers 40 and 49. The data from the two sources were in close agreement. Rainfall values from the Weather Bureau papers were used.

STREAMFLOW

There are no streamflow records for the watershed. Estimates of peak flow for several recent large floods have been made by SCS and the U. S. Geological Survey. A frequency study of records from the Rio Felix Watershed north of and adjacent to Eagle Draw were analyzed and the results used to help estimate frequencies of recent floods.

SOIL COVER COMPLEXES

Hydrologic soil groups were established from data obtained from the standard soil survey of the watershed area. Cover types and hydrologic condition were determined by field reconnaissance.

SURVEYS

Topographic surveys of reservoir sites were used to determine stage-storage relationship. Channel cross-sections and profiles were taken for flood routing and design of improved channels. Time of concentration was determined by the Kirpick nomograph and channel hydraulics. A base map of the watershed was prepared from U. S. Geological Survey quadrangle sheets. Sub-watershed boundaries were outlined and soil cover complex data tabulated on the map.

EVALUATION HYDROLOGY

Historical flood events have occurred in 1905, 1908, 1911, 1919, 1928, 1937, 1941, 1948, 1954, 1964 and 1966. A flood frequency was estimated

for the 1954, 1964 and 1966 floods based upon a study of regional flood peaks and ranking of these floods according to the records of area flooded, damages, etc. The frequency at which flood damages begin for both the urban and agricultural areas was estimated from interviews with local residents. The evaluation was performed for: (A) present conditions, (B) future conditions with structural measures installed.

Evaluation of the project was based on historical flood information. Frequency-peak discharge-damage relations were developed for present conditions using the historical information and the frequency study of records from the Rio Felix Watershed.

Damages in the urban area under future conditions with project will be negligible by virtue of a channel constructed through the City of Artesia. The remaining damages to the agricultural area east of Artesia is considered negligible due to the high level of control to the urban area above. Residual damages for the remainder of the agricultural land were evaluated by developing a synthetic storm series for the uncontrolled drainage area below Site 2B. These peak flows were correlated to the frequency-peak discharge-damage relations developed for present conditions.

A qualitative analysis was made to relate the water yield under present conditions and under future conditions with the proposed structural measures installed. Consideration was given to the effects of the structural measures on surface runoff and to groundwater recharge. In brief, the analysis related (1) the direct flow to the Pecos River, (2) evaporation and (3) infiltration under present conditions to the same parameters under future conditions.

HYDROLOGIC DESIGN

The principal spillway capacity of the floodwater retarding structure was sized in accordance with criteria from the New Mexico State Engineer and to meet minimum requirements of SCS Engineering Memorandum 27 (rev.). Floodwater storage requirement was determined by the procedure outlined in National Engineering Handbook, Section 4, Chapter 21. The runoff volume was adjusted for channel transmission losses by the method of Chapter 21, Section 4, National Engineering Handbook with these values modified according to the dominant hydrologic soil group occurring in the watershed.

Emergency spillway and freeboard design hydrographs were developed using procedures in Chapter 21, Section 4, NEH and criteria from SCS Engineering Memo 27 (rev.). An areal adjustment for rainfall used in spillway design hydrographs was developed after consultation with the Special Studies Branch of the Weather Bureau.

The routing of the emergency spillway design hydrograph through the structure beginning at the top of the sediment pool was the basis for selection of the proper design and proportion of the emergency spillway control

section. The U. D. Method of Reservoir Flood Routing was used for flood routing through the structure.

Design flows for the Eagle outlet channel were computed using composite peak flows developed from structure outflow and flow from intermediate drainages. Design flows for the floodwater diversions were computed using the procedure in National Engineering Handbook, Section 4, Chapter 21.

G E O L O G Y

SEDIMENTATION AND RELATED INVESTIGATIONS

Field investigations pertaining to sediment problems in the watershed were made in accordance with prescribed Soil Conservation Service guidelines. Computation of yields and allocation of sediment storage were made in accordance with methods set forth in Soil Conservation Service Technical Release 12 and Engineering Memorandum 27 (rev.), Supplement 1. Field studies included reconnaissance surveys of geology and physiography, slope percent and length, groundcover and soils. Soils series were transposed to U. S. Geological Survey topographic sheets from the latest Soil Conservation Service soils maps. Sediment damage to the City of Artesia and to the irrigated lands was determined by interviews with the owners and operators concerned.

CHANNEL STABILITY INVESTIGATIONS

Reconnaissance investigations were made to determine stream channel stability below the principal spillway outlet of the proposed structure.

A total of 127 feet of auger holes and backhoe pits were examined and sampled. Coarse-grained samples were sieved and grain-size distribution curves drafted. Selected fine-grained samples were analyzed in the laboratory for grain-size distribution, plasticity index and permeability. Field classification of materials in the proposed channel was used in conjunction with the table in Figure 6-1 of Technical Release 25 in estimating stability characteristics of the outlet channel. Two undisturbed samples were tested for saturated unconfined compressive strength. The results of these and additional analyses and tests will be used in determining channel stability for design purposes.

GEOLOGIC INVESTIGATIONS

A preliminary site investigation was made at the proposed structure Site 2B location in accordance with Engineering Memo-33 (rev.). The investigation included a field investigation of all surface features and use of a rotary drill rig and backhoe to determine subsurface conditions.

Eleven exploratory holes ranging down to 60 feet in depth were drilled along the proposed centerline of dam. Drill hole cuttings were collected and logged as drilling progressed. Field testing consisted of sieve analysis of the coarser materials, one permeability test which indicated permeability rates of approximately five feet per day, a natural moisture test and Atterberg tests to determine plasticity of the materials. An undisturbed sample was collected to check characteristics of the plastic material at depth.

Additional exploration consisted of twelve backhoe pits ranging in depth from 9 to 13 feet in the proposed borrow areas. Field testing consisted of sieve analyses and Atterberg testing. There is sufficient borrow material, both in quantity and quality, available within the reservoir area.

Site 2B is located on Pleistocene and Recent Age alluvium of the Blackdom Terrace. Materials in the foundation consist of clay with interbedded lenses of clayey gravels occasionally cemented by caliche. Foundation conditions are satisfactory, and it is estimated all excavation will be common.

Detailed site investigations including laboratory analyses and testing of foundation and fill materials will be made prior to final design and construction.

E C O N O M I C S

DETERMINATION OF DAMAGES

All known sources of information on flood damage were contacted, including farm owners and operators, railroad officials, state and county road officials. Newspaper files were also consulted. Information was obtained for floods that occurred in 1905, 1908, 1911, 1919, 1928, 1937, 1941, 1948, 1954, 1964 and 1966.

Agricultural damage estimates were based on information contained in schedules obtained from farm owners and operators on about 41 percent of the agricultural units in the flood plain. These schedules covered land use, crop distribution, yields, historical data and flood damage.

In the calculation of crop and pasture damage, expenses saved, such as the cost of harvesting and other production inputs, were deducted from the gross value of the damage. The floodplain land use was mapped in the field. Estimates of normal flood-free yields were based on data obtained from schedules supplemented by information from other agricultural workers in the area and from secondary sources.

The damageable value for crops and pasture grown in the watershed was determined from actual costs and returns of agricultural production as experienced by local farmers.

Subsequent to the establishment of damageable values, a crop damage factor was then developed for each crop. This crop damage factor is based on the probability of local damaging floods occurring by months throughout the growing season, depths of flooding and percent reduction of local crop yields. It also reflected losses from reduction in crop yields, damage to quality of cotton and alfalfa, increased production cost, increased maintenance cost and other agricultural losses.

From this the flood damage was determined on a composite acre basis. A composite acre is one acre of land apportioned to all the same uses and in the same ratio as the entire area being evaluated. The area being evaluated in this instance refers to the area subject to floodwater inundation.

Total damages can thus be determined according to the total number of acres inundated and the depth of flooding from storms of various frequency.

This was applied to acres flooded by depth increments to selected storms within each evaluation reach for both with and without project conditions. Resultant damages were converted to an annual equivalent basis. The difference represents damage reduction benefits. No attempt was made to separate sediment and floodwater damage because the sediment damage was considered insignificant.

Average annual crop and pasture damage was determined by using the "peak-discharge-area inundated relationship" developed in the hydrologic analysis. This analysis, developed by the planning staff hydrologist, includes storms or floods up to and including the one percent chance event. This analysis gave the area and depth of inundation for each size storm used in the evaluation.

A substantial degree of intensification of agricultural production is anticipated in the future. Although intensification benefits were not claimed for the project as such, it was necessary to establish the extent of this expected intensification and reflect it in the various aspects of the agricultural damage evaluation. As a result, damage appraisal on agricultural property reflects higher damageable values under future conditions than present conditions indicated.

The economic analysis was based on evaluations of flood information on agricultural damages from the 1964 and 1966 storms.

In regard to urban damage evaluation, random damage appraisals were made of residences in the northern part of the city, and all commercial establishments were appraised. This information was then compared with Red Cross damage information that was collected subsequent to the 1964 flood.

The area damaged by flooding within the city was then delineated. This amounted to four general areas which were labeled "Damage Areas 1, 2, 3, and 4".

-Determination of Damages-

Average residential property values were established primarily through the Urban Renewal Administration. The Stanford Research Institute (SRI) curves were applied to these values to arrive at total damage values per unit or residence.

These damage values per home were cross-checked with the actual random appraisals and were found to be within 4.5 percent.

Upon establishing the reliability of the SRI curves as related to damages in Artesia, these curves were applied and projected to all residences subject to flooding which were grouped according to average market value, depth of flooding from the 1964 flood and damage areas.

To project future growth and determine future damages, a population projection by the Business Research Bureau of the University of New Mexico was used. This revealed the population of the City of Artesia could be expected to increase 22,000 by the year 2000. Based on an average of five persons per home, this would mean approximately 4,400 new residences would be added to the city by that time.

Based on a letter of information from the city mayor, dated December 9, 1969, projected home construction was also grouped by damage areas, projected market values and probable depths of flooding. The SRI curves were then applied to this data. The resulting damage values were then discounted back from the year 1980 or 2000 to present-day value. These were combined with existing damages to arrive at total residential damages that would occur from a flood similar to 1964.

This amount of damage was plotted as a point on a damage frequency curve for each damage area. The frequency at which damages are expected to begin was also plotted. The two points were connected and the line was extended to a 100-year frequency. The area under this curve was measured and considered as being average annual residential damages for each area.

Average annual commercial damages were determined by actual appraisal. The average damage per business was established as well as the average number of people per business. This was projected to the year 2000 to arrive at the number anticipated by then.

The 1964 flood damaged approximately 26 percent of the business establishments. This percentage was applied to the total projected number of businesses by the year 2000 to arrive at future flood damages anticipated by a flood similar to 1964.

This was plotted on a damage frequency graph similar to those used for determining residential damages. The point at which damages begin was also plotted and a line connected the two points. The area measured under this curve then came to be the average annual commercial damages.

There will be no remaining damages to residential and commercial properties with the project installed.

In order to allow for future increased urban damage values, a factor of 2.20 (factor for Pecos Water and Resources Planning Area, #12552 @ 5 1/8 percent interest), was applied to the residential and commercial damages as adjusted to the normalized price base. This factor was based on personal disposable income trends projected by the Office of Business Economics for the area in which the watershed is located.

The flood damage reduction benefits in Artesia have been computed on the basis of the Urban Renewal Channel being in place.

REDEVELOPMENT BENEFITS

Redevelopment benefits were claimed on the basis of authority set forth in paragraph 102.02212 of the Watershed Protection Handbook.

With the watershed being located partly in Chaves County and partly in Eddy County, it is within an area designated by the Public Works and Economic Development Act of 1965 as being an area of chronic unemployment and underemployment. The latter pertains directly to Eddy County. Chaves County is in the Four Corners Development Area which is also associated with this act.

When a watershed is in an area so designated, the evaluation of redevelopment benefits is to be based on Appalachia Criteria contained in Appalachian Memo-2 dated July 1, 1965. This is:

1. Wage rates to local labor during construction are to be 30 percent of construction cost.
2. Value of annual wages paid to local labor is to be 50 percent of annual operation and maintenance costs.
3. Benefits from O&M to be evaluated on a descending scale for a 25-year period.

In this project, redevelopment benefits evaluated from the employment of local labor for project installation which would otherwise be underemployed or unemployed would average \$91,100 annually. Likewise, benefits were also evaluated from the employment of labor to operate and maintain the project that would otherwise be unemployed or underemployed. Based on Appalachia Criteria, this employment situation would be very unlikely to persist. Therefore, evaluation of these benefits were based on the first 25 years of the project period. They would average \$4,500 annually. Total redevelopment benefits would amount to \$95,600 per year.

SECONDARY BENEFITS

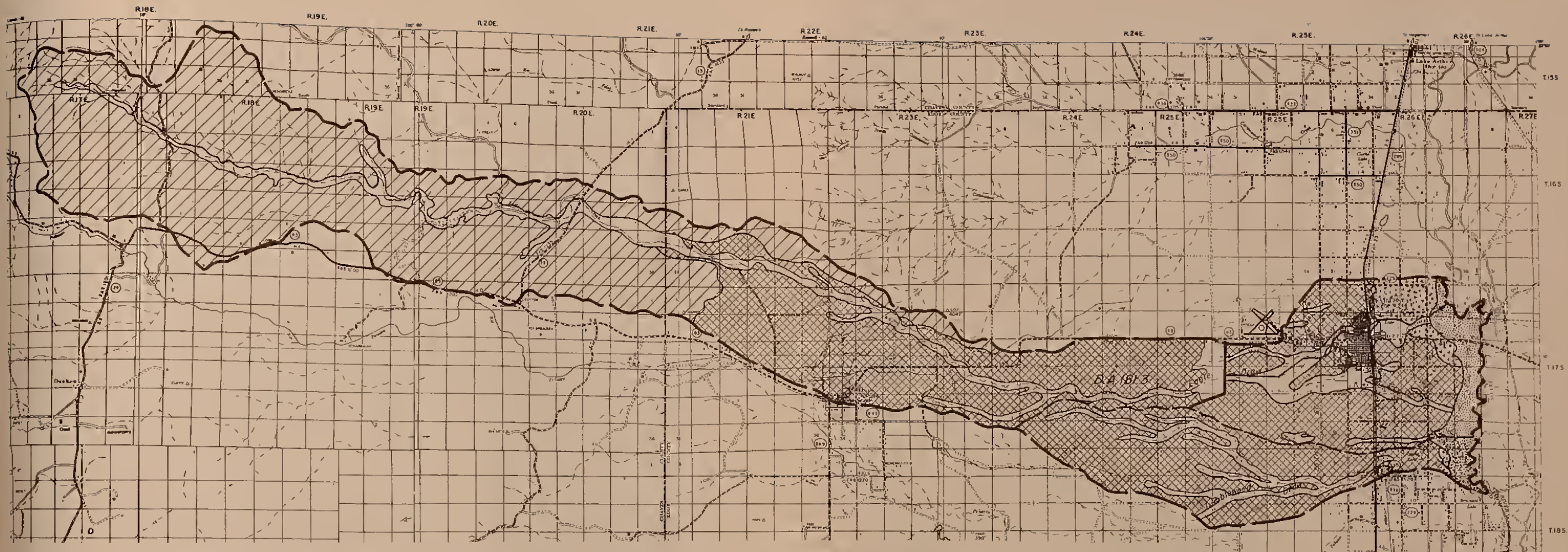
These are benefits "stemming from" or arising from the increased production of goods and services as a result of the project. They also include benefits

-Secondary Benefits-

"induced" by the project. These induced benefits are increased expenditures by people in the area as a result of the project.

Secondary benefits are estimated to be equal to 10 percent of direct primary benefits exclusive of indirect damage reduction benefits and 10 percent of annual O&M costs. Direct primary benefits of this project are flood damage reduction benefits only. The total secondary average annual benefits of this project are estimated to be \$64,400.





This map is intended for general planning. Each delineation may contain soils having ratings different from those shown on the map. Use detailed soil maps for operational planning, and on site inspection for more detailed decisions.

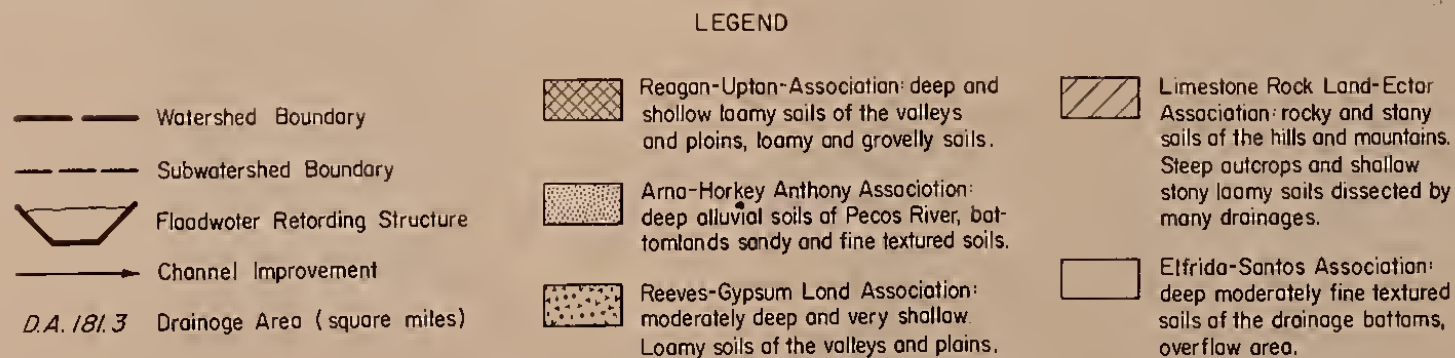
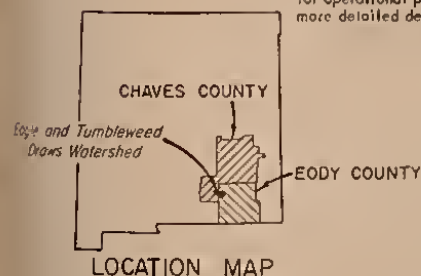
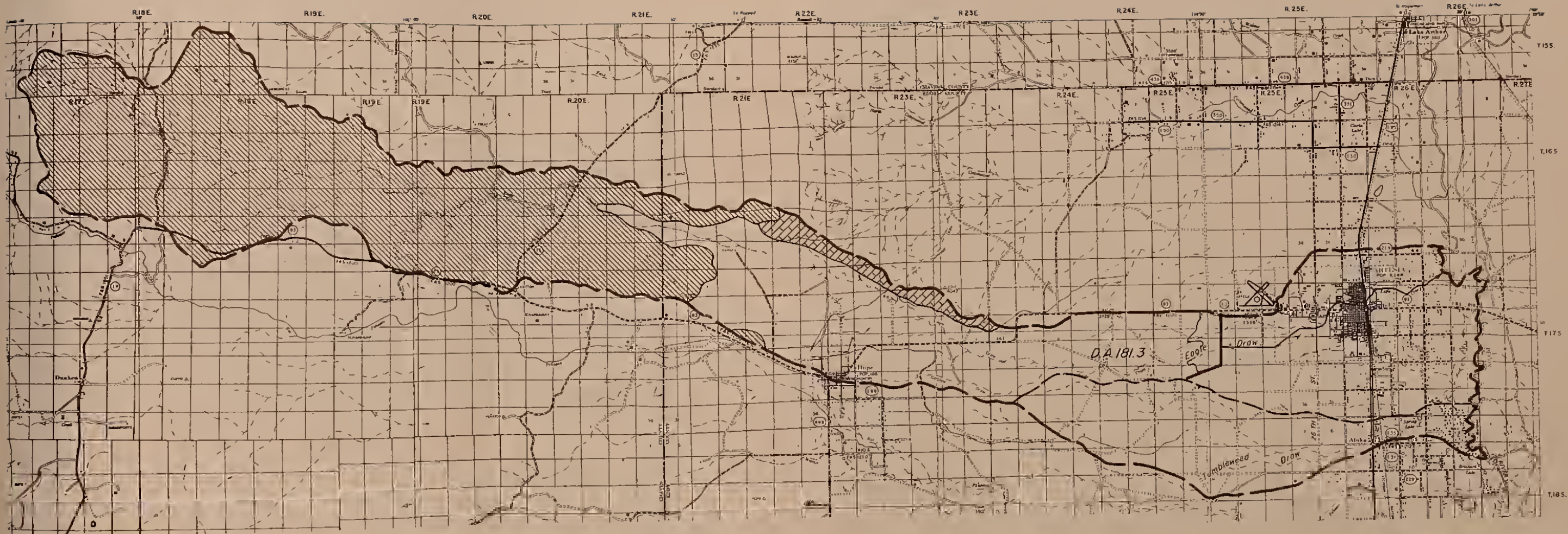


FIGURE 1
GENERAL SOIL MAP
 EAGLE AND TUMBLEWEED DRAWS WATERSHED
 CHAVES AND EDDY COUNTIES, NEW MEXICO
 U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE
 APRIL 1970
 0 1 2 3 4 5 Miles
 SCALE 1:253,440
 Compiled from New Mexico State Highway Department Quads.



LEGEND

- Watershed Boundary
- - - Subwatershed Boundary
- ▤ Floodwater Retarding Structure
- Channel Improvement
- D.A. 181.3 Drainage Area (square miles)

- Alluvium
- ▨ Limestone Conglomerate
- ▩ San Andres Limestone

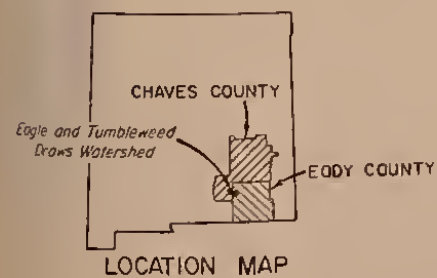


FIGURE 2
GEOLOGY MAP
EAGLE AND TUMBLEWEED DRAWS WATERSHED
CHAVES AND EDDY COUNTIES, NEW MEXICO

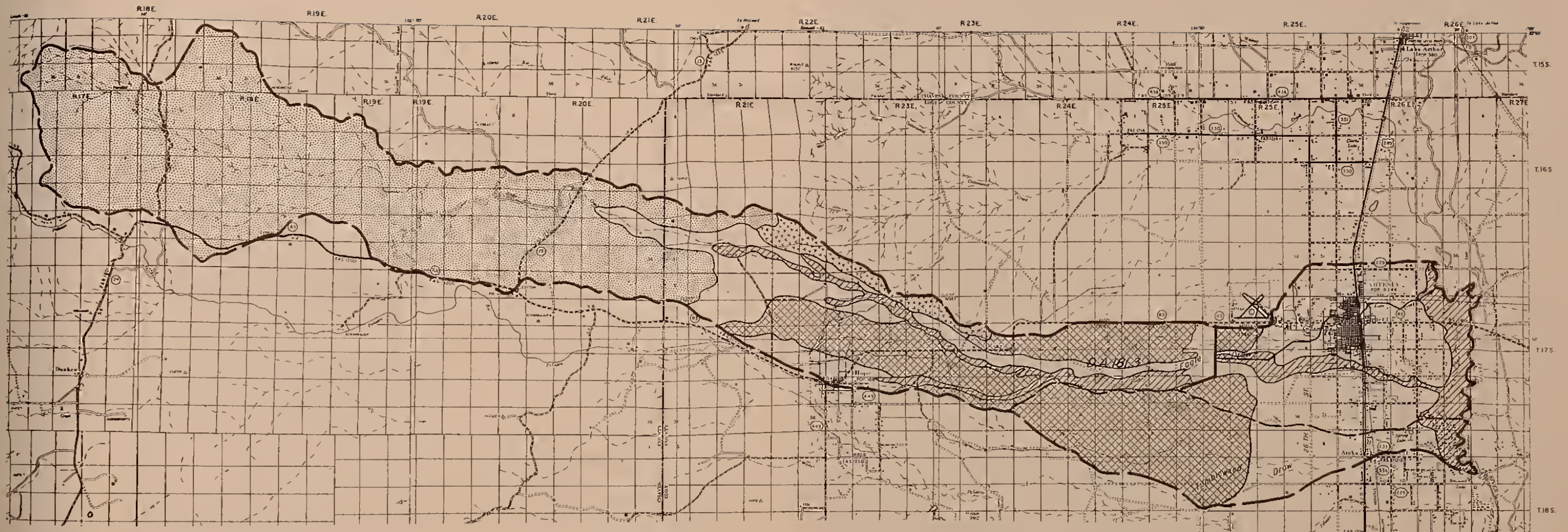
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

APRIL 1970

0 1 2 3 4 5 Miles
SCALE 1:263,440

Compiled from New Mexico State Highway Department Quads.

M7-E-215B5B-N



LEGEND

- | | | | |
|-------------------|--------------------------------|--|----------------------|
| | Watershed Boundary | | Lakewood Terrace |
| | Subwatershed Boundary | | Orchard Park Terrace |
| | Floodwater Retarding Structure | | Blackdom Terrace |
| | Channel Improvement | | Grovel-capped Mesas |
| <i>D.A. 181.3</i> | Drainage Area (square miles) | | Permian Rock |

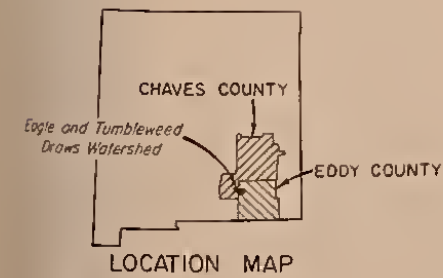


FIGURE 3
GEOMORPHOLOGY MAP
 EAGLE AND TUMBLEWEED DRAWS WATERSHED
 CHAVES AND EDDY COUNTIES, NEW MEXICO

U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

APRIL 1970

0 1 2 3 4 5 Miles
 SCALE 1:253,440

Compiled From New Mexico State Highway Department Quads.

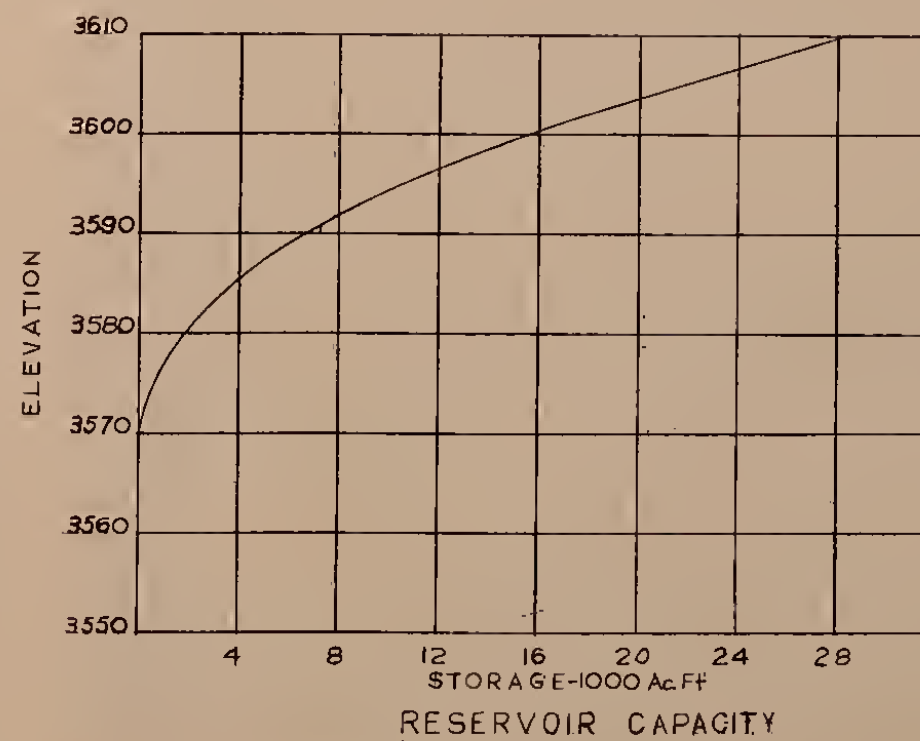
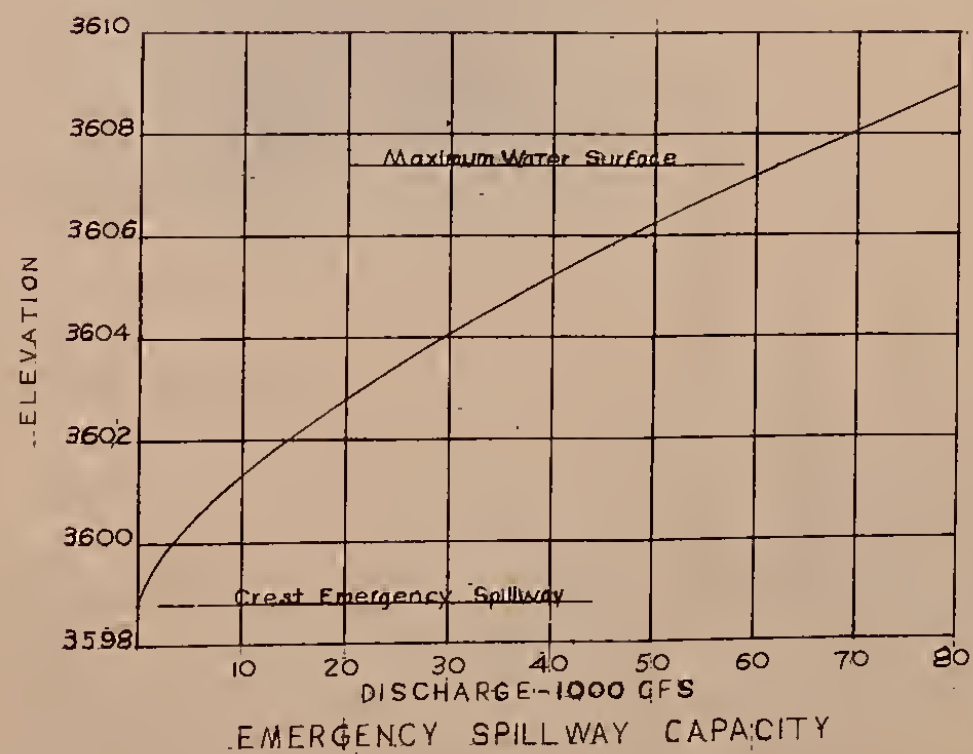
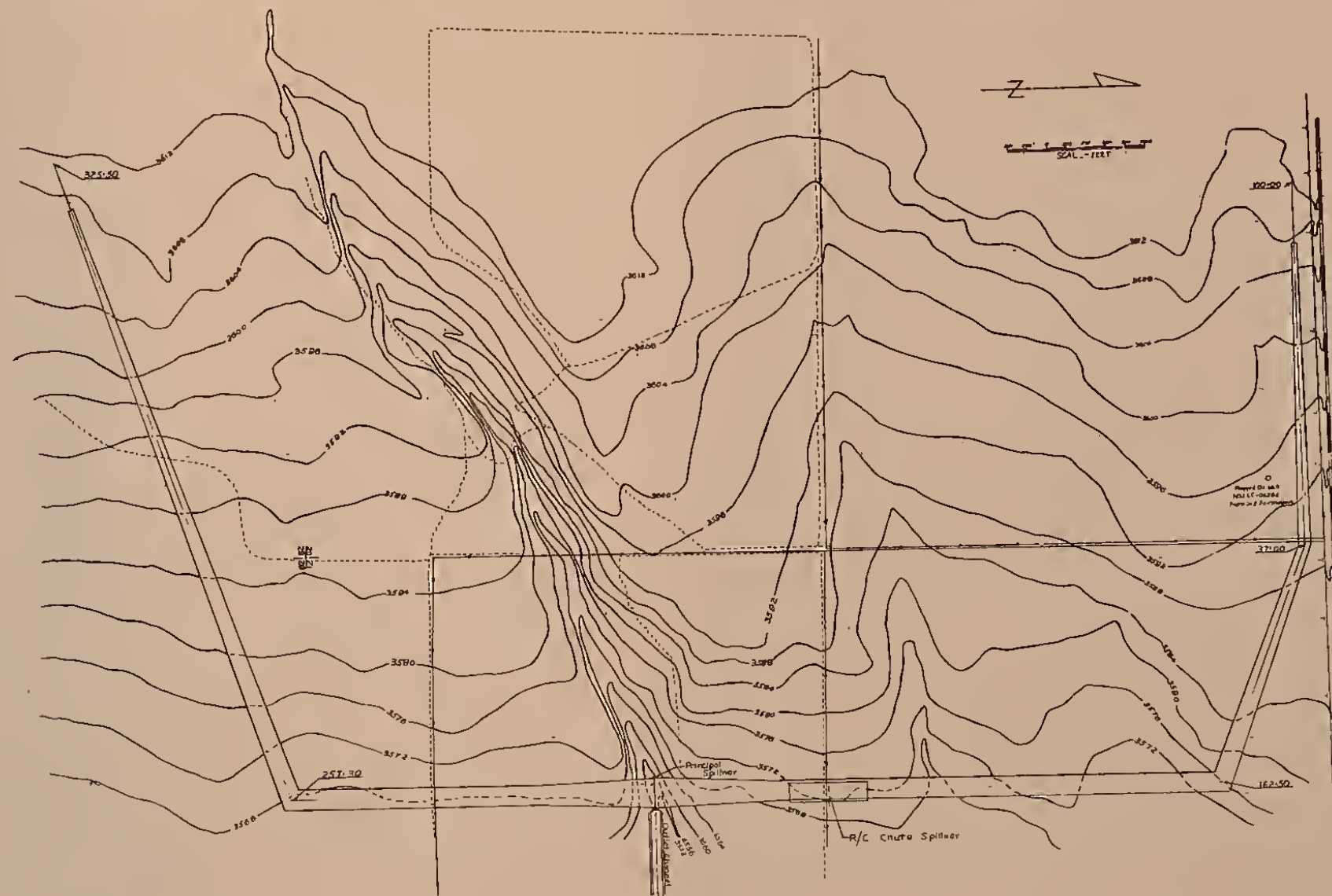


FIGURE 4

FLOODWATER RETARDING STRUCTURE
SITE 2B
EAGLE-TUMBLEWEED DRAW WATERSHED
EDDY-CHAVES COUNTIES NEW MEXICO

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed.....	Date.....	Approved by.....
Drawn.....	Title.....	
Traced C. M. JACKSON.....	11/88	Sheet.....
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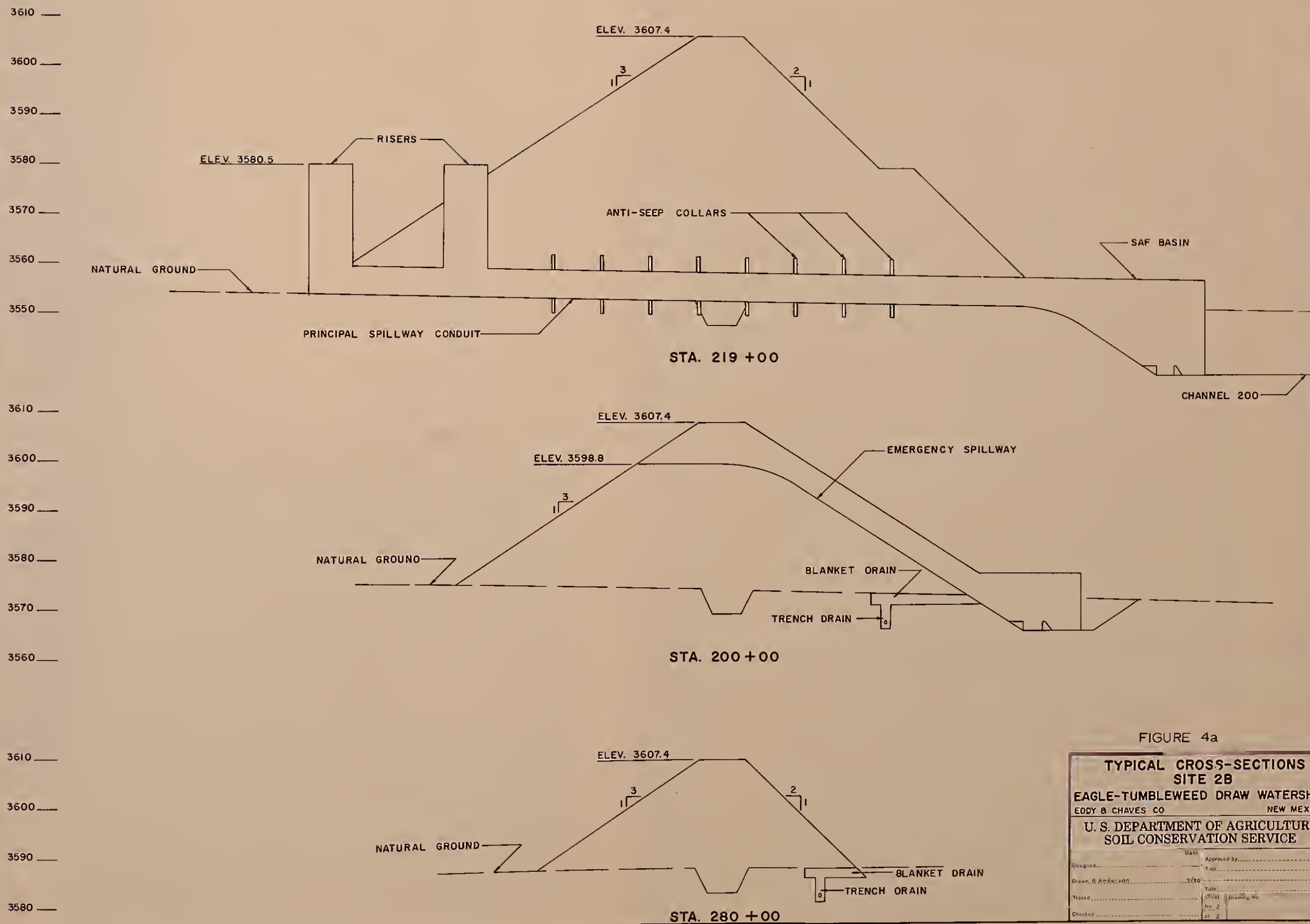


FIGURE 4a

TYPICAL CROSS-SECTIONS SITE 2B			
EAGLE-TUMBLEWEED DRAW WATERSHED			
EDDY & CHAVES CO		NEW MEXICO	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE			
Designed	Date	Approved by	
Drawn, R. Anderson	Title	Title	
Traced	Title	Title	
Checked	Sheet	Drawing No.	
	No. 2		
	of 2		

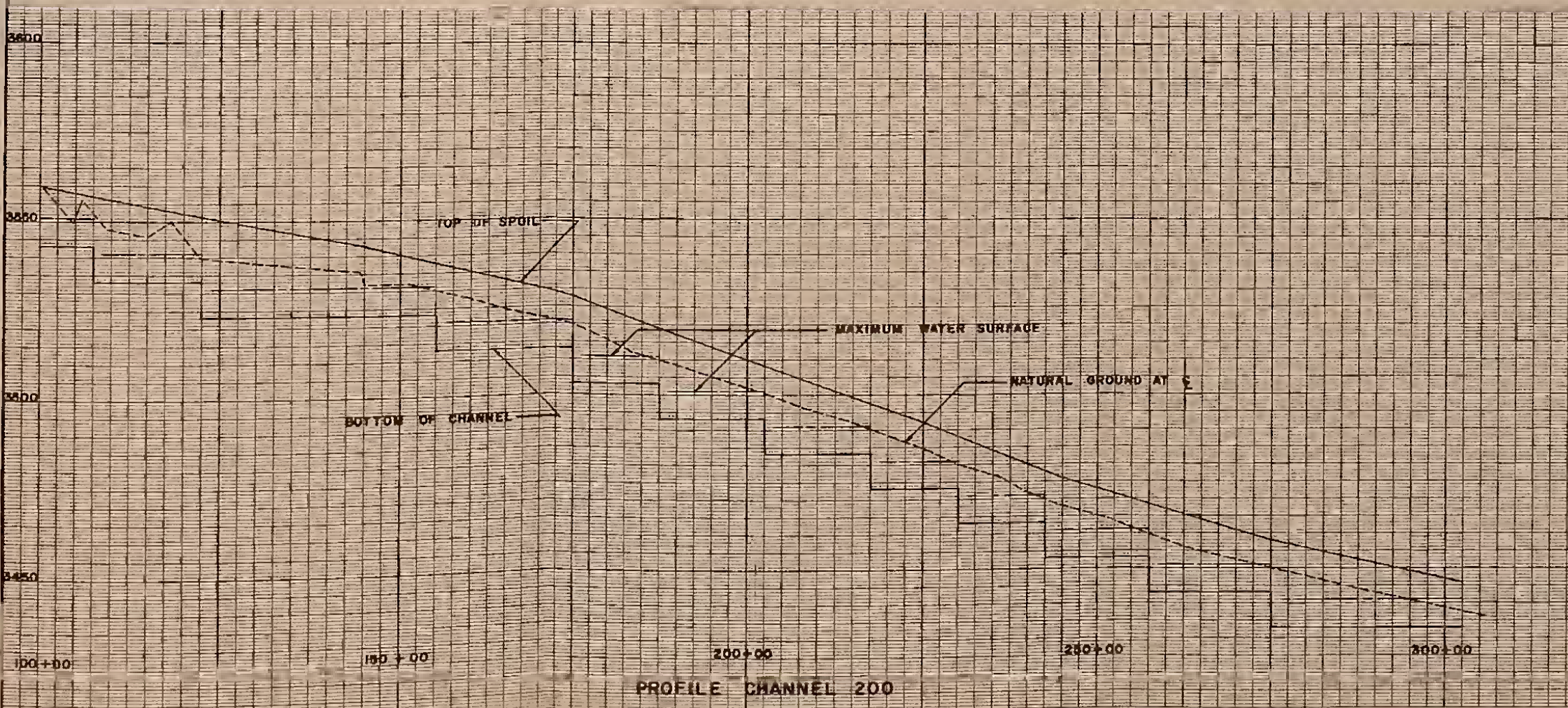
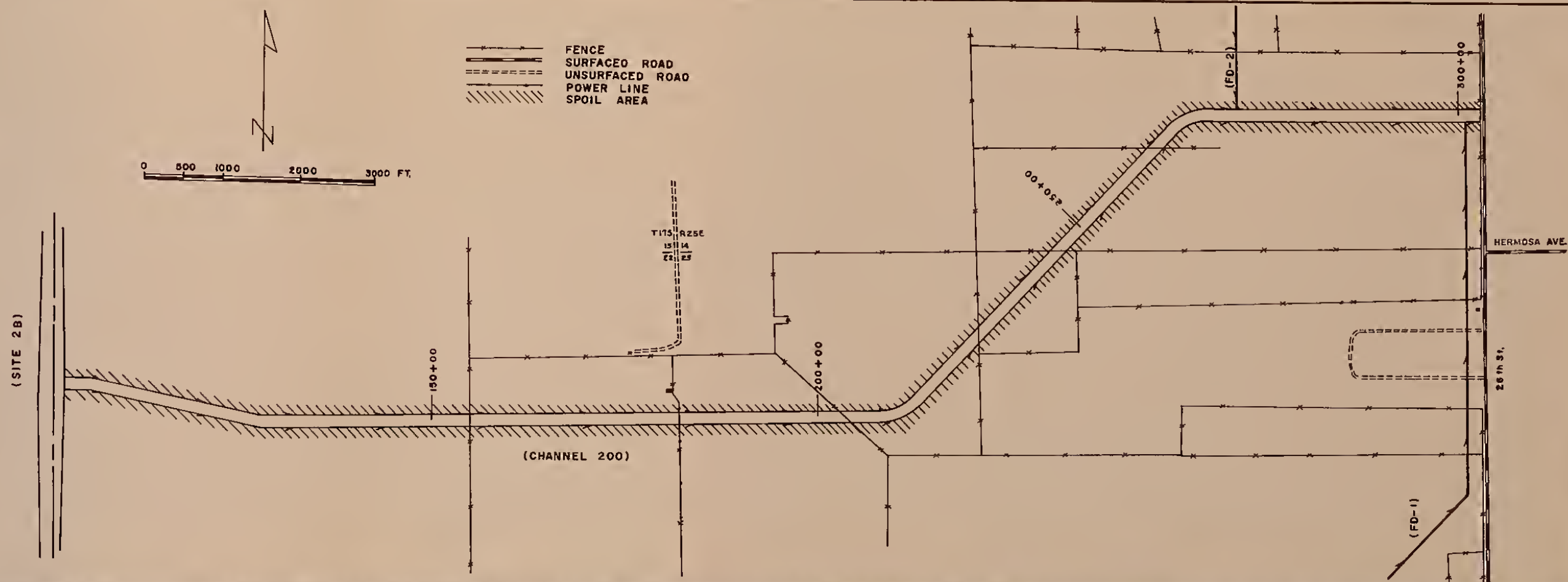
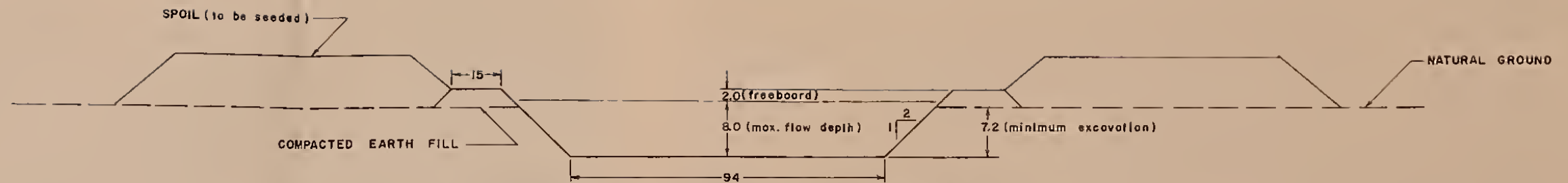


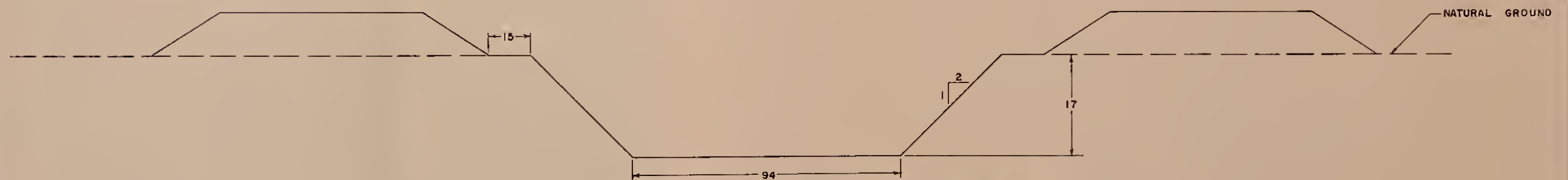
FIGURE 5

PLAN & PROFILE
CHANNEL 200, FD-1 & FD-2
EAGLE-TUMBLEWEED DRAW WATERSHED
EDDY & CHAVES CO. NEW MEXICO
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

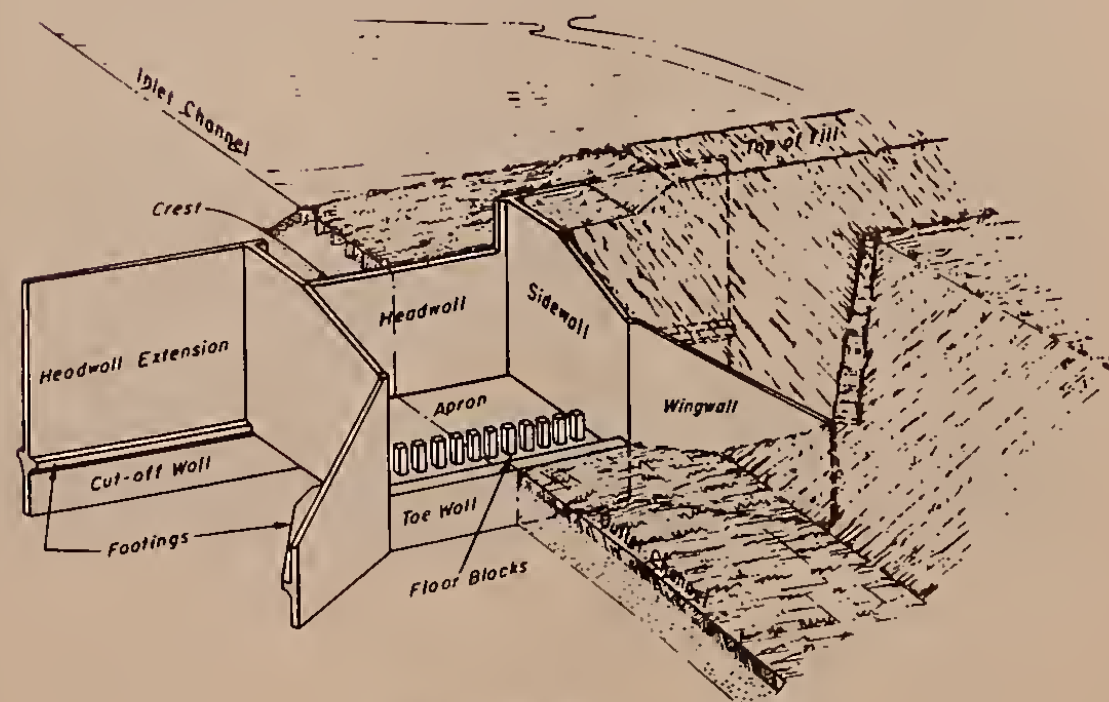
Designed.....	Date.....	Approved by.....
Drawn A. Anderson	7/70	Title.....
Traced.....	Sheet.....	Drawing No.....
Checked.....	No. 1	
	of 2	



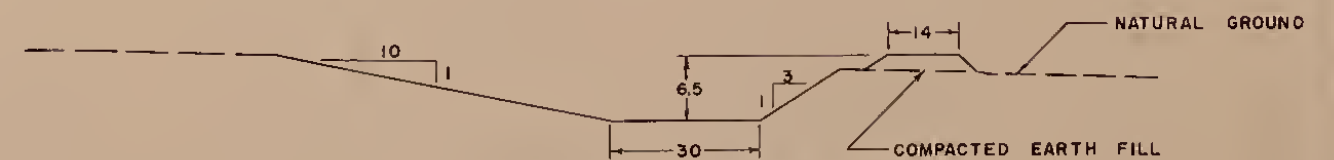
TYPICAL CROSS-SECTION UPSTREAM FROM DROP STRUCTURES
CHANNEL 200



TYPICAL CROSS-SECTION DOWNSTREAM FROM DROP STRUCTURES
CHANNEL 200



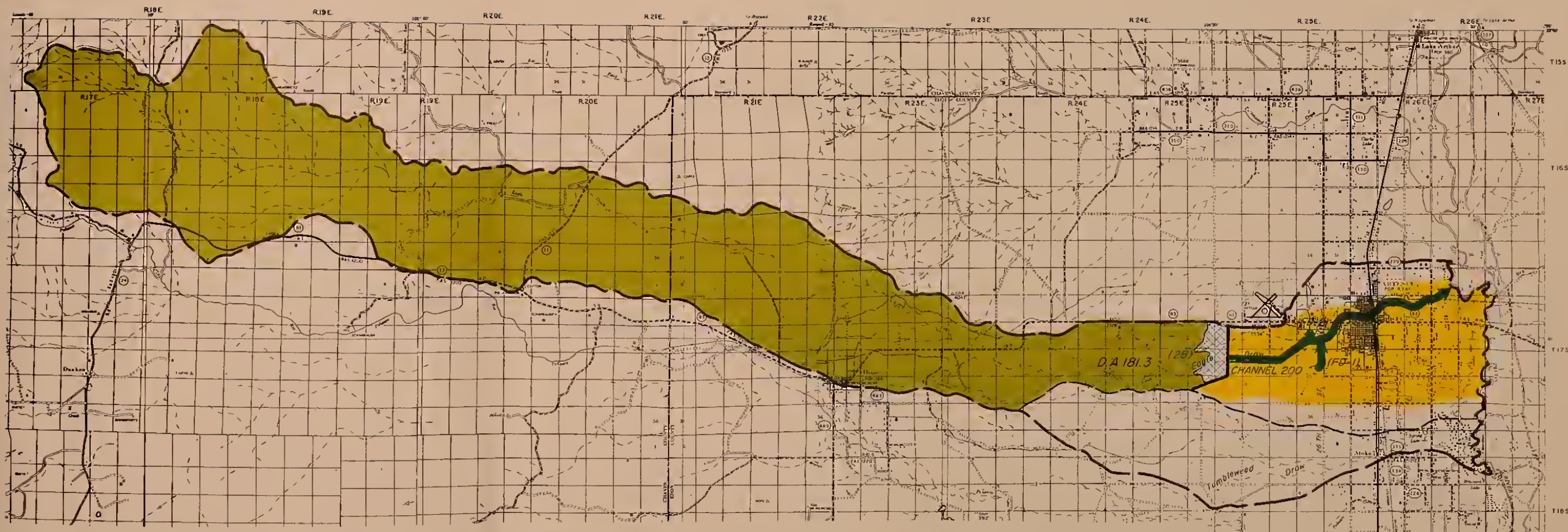
STRAIGHT DROP SPILLWAY
TYPICAL STABILIZATION STRUCTURE







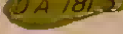

TYPICAL CROSS-SECTION OF DIVERSION
FO-1

FIGURE 5a

TYPICAL CROSS-SECTIONS CHANNEL 200, FO-1 & FO-2 EAGLE-TUMBLEWEED ORAW WATERSHED EDDY & CHAVES CD NEW MEXICO U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE			
Designed	Date	Appr. ed by	Title
Drawn R. Anderson	7/70		
Issued	Sheet	Drawing No.	
Checked	No. 2	of 2	



LEGEND

-  Watershed Boundary
-  Subwatershed Boundary
-  Floodwater Retarding Structure
-  Channel Improvement
-  Drainage Area Controlled (square miles)
-  Area Benefited

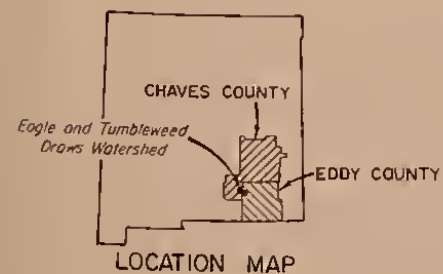


FIGURE 7

PROJECT MAP EAGLE AND TUMBLEWEED DRAWS WATERSHED CHAVES AND EDDY COUNTIES, NEW MEXICO

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

APRIL 1970

0 1 2 3 4 5 Miles
SCALE 1:253,440

Compiled from New Mexico State Highway Department Quads.

M7-E-21585D-N



